

EXE

OCTOBER 1993

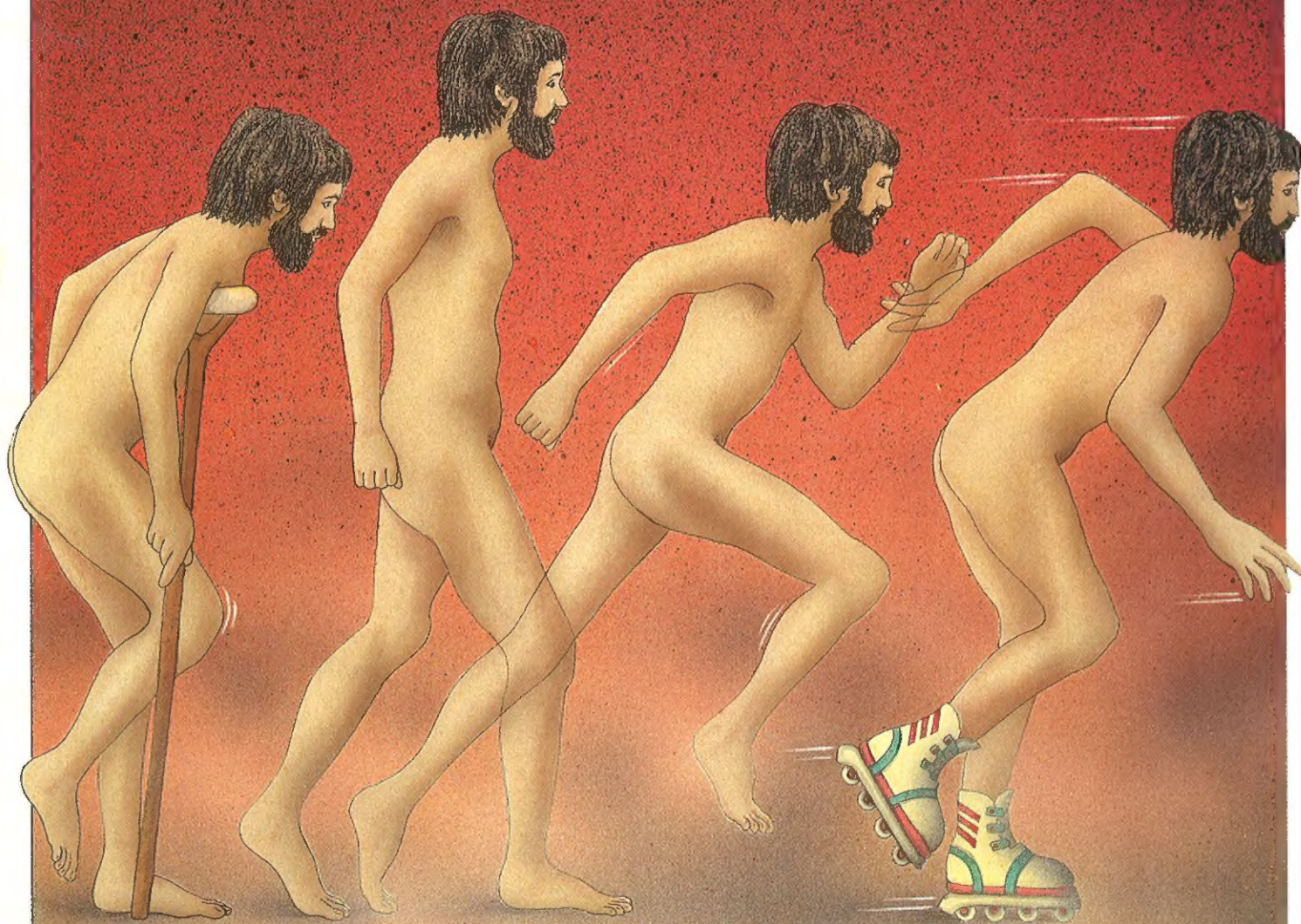
VOL 8

ISSUE 5

£3.20

The Software Developers' Magazine

SPECIAL REPORT
CA speaks on Visual Objects



*Don't be a pedestrian developer.
Put on your rollerblades with 4GLs.*

*Clarion Database Developer -
Is it really the app gen built on speed?*

*Predicting seemingly random sequences:
We show how to test randomness.*

Transaction processing - Ingres reveals all.

*Much ado about RDDs.
Our man Guy Smith lends a helping hand.*

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Circle Info
060

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Printed by: Chase Web Ltd, St Ives plc

General

.EXE Magazine is independent and not affiliated to any vendor of hardware, software or services. It is published by Process Communications Ltd, 10 Barley Mow Passage, Chiswick, London W4 4PH.

Tel: (Advertising/Editorial/Production) 081 994 6477
 (Subscriptions) 081 994 6477

Facsimile: 081 995 7775 Telex: 8811418 SPACES G
 ISSN: 0268-6872

Subscriptions

.EXE Magazine is a monthly journal for software developers. It is available only by subscription, at a cost of £35 per annum (12 issues) in the UK, £56 for 2 years. Overseas subscriptions cost £50 per annum, £70 for 2 years. 'A subscription implies that this journal will be sent to the subscriber until one of the three expires' - AG Macdonell. The magazine is published around the 26th of the month preceding the cover date. To subscribe or obtain details of overseas/academic rates, please call 081 994 6477, or write to The Subscriptions Manager, .EXE Magazine, 10 Barley Mow Passage, Chiswick, London W4 4PH. We can invoice your company or take ACCESS and VISA cards. In case of a query about your subscription, please call 081 994 6477. Back issues are available at a cost of £3.50 each - call our Chiswick office (081 994 6477) for a list of issues still in print.

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Pronunciation

.EXE Magazine rhymes with 'not sexy magazine'.

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Changing Religions

*In some people's eyes assembler programming is a sin.
Chris Hall believes it fulfils a crucial role in computing today.*

People no longer consider assembler as an alternative to the crop of so-called structured high-level languages such as C or Pascal. For years they have been brainwashed into (wrongly) believing assembler to be evil. There are applications for which assembler is ideal. Assembler should not be excluded on quasi-religious grounds. Don't be fooled by those who preach: 'Assembler Considered Harmful'. We should use the right tool for the right job. And if that means lapsing into assembler, then assembler it will have to be.

Assembler is at its best where speed and/or size are critical. However, if portability is a requirement, then (obviously) you cannot use assembler.

If you have tight memory or speed constraints, then assembler is what you need. If memory is short you might need to code entirely in assembler. If speed is your sole concern, then you can most likely identify key functions for hand-coding in assembler. This is the practice of fine-tuning that 10% of code which the program spend 90% of its time executing.

Compilers are getting better at generating code; processors are getting better at running the code they churn out. Still, humans are better code generators than compilers. With assembler, you get less code, so it runs faster. And it's smaller too.

Even on a machine overflowing with MIPS and megabytes, a dash of assembler can make all the difference, especially when dealing with the response time for the user-interface. Device drivers and the like are also excellent candidates for assembler. Given the choice wouldn't you buy the faster device with the smaller memory overhead?

Then there are the machines where build cost is critical. If you want to ship a \$400 hand-held computer, then the difference between a \$1 8086 (or even a 50¢ Z80) and a \$20 386 is highly significant! By writing code in assembler, you can get the utmost from limited processor speed and memory. With embedded software, such as the software in printers, assembler can improve performance (eg a faster PostScript interpreter) or reduce

the processor and/or ROM requirement, thus reducing the overall cost of the unit.

The benefits of using assembler must be balanced against the costs. Can the cost of, say, doubling the speed of a given program, be justified?

Opponents of assembler often claim that it is quicker to write programs in high-level languages, and the result is cheaper to test and maintain. The same could be said of 4GLs and application generators.



This is only partially true. In assembler, the programmer has to deal with more detail, implying more work. Assembler does not support or encourage any program structure - the programmer has to enforce this himself. Assembler code is not inherently readable, so the programmer must compensate by commenting liberally.

This does not mean, however, that there is any fundamental difference between assembler and high-level language programming. All the structured programming lessons we have learnt apply equally well to assembler as to C or Pascal. If there is a difference between assembler and high-level languages, then it is that greater attention must be paid to good practice with assembler, because it is an unforgiving language.

There is a dangerous notion that high-level language code can be largely 'self

documenting'. The situation worsens in the domain of 4GLs and application generators. The danger is that programmers become lazy about commenting their code - three months later, something that once looked obvious now takes time to re-interpret.

Assembler does not add significantly to the design cost of a program. The testing and maintenance costs of a program are most influenced by the quality of the design and the level of understanding that can be gleaned from (commented) code.

Coding contributes a relatively small proportion of the total cost of a project. I believe the extra cost of using assembler, instead of C or Pascal, does not increase significantly the total cost of a project.

To write cost-effective assembler requires special skills and a disciplined approach. The general fear of assembler is self-fulfilling. If you don't have the necessary expertise, then you can indeed produce horribly unstructured, undocumented, unreliable and unmaintainable assembler. If you never use assembler because of the 'well known drawbacks', then you'll never develop the expertise.

Instead of using assembler, some developers will relax speed or space constraints, or simply upgrade processor or memory requirements. They may struggle to tune their high-level language code, to fool their compiler into yielding the required performance - all of which effort may be negated by the next compiler release.

Assembler is appropriate in special circumstances. In the right hands it is more cost effective than many think. It is said that an engineer is someone who can make for 10p what any fool can make for £1. Anyone who won't even consider assembler -- because it's a Bad Thing -- is not an engineer!

[EXE]

Chris Hall is the Managing Director of Locomotive Software, who has been perfecting assembler skills for more years than he cares to think about. He can be contacted by telephone on 0306 742140, or by email: chris@locomotive.com.

C & C++ COMPILERS

NEW MICROSOFT VISUAL C++ 32-BIT EDITION is the compiler used by Microsoft to build Windows NT. Fully NT-hosted, with multi-threaded IDE, enhanced debugger, advanced Pentium optimisations, 32-bit version of MFC 2. It also targets and includes Win32s for those with Windows 3.1. It is only available on CD-ROM, which is fully exploited by Books Online - more than 10,000 pages of documentation, fully indexed and cross-referenced. Is this "Information At Your Fingertips"? Printed Docs available separately for those who read in bed! **UPGRADE FROM VISUAL C++ PROFESSIONAL - ONLY £74.**
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News & Views

Windows NT is Now There and so is Microsoft's Visual C++ 32-bit Edition. Apart from being the same compiler which Dave Cutler uses, it is the first developer's tool which exploits the power of CD-ROM and ships without any printed documentation (should save a few trees!). It includes a cut down version of Phar Lap's new TNT DOS Extender, which lets you develop 32-bit DOS apps which incorporate threads & DLL's. Who needs NT?! Once you have tried it, call us to buy a full copy.

For those of you Bored with Borland and Miffed with Microsoft, why not check out the new Symantec C++ 6.0. Preliminary reports suggest that it will be more visual than Visual C++ with faster compilation and linking, and some novel features in its IDE. The big question is - WILL IT WORK? If it does, and the documentation is adequate, it could supercede both Borland C++ and Visual C++ as the most productive C++ compiler for Windows. Call us to find out more about it.

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Oracle class lib

Rogue Wave's DB.b++ database class library for C++ has been updated to support Oracle V7.0 and Visual C++. The company is targeting this release at users of Oracle who are planning to move to C++. DB.b++ V1.5 is available on several platforms including DOS, Windows 3.x, OS/2 and a number of UNIX platforms. The DOS version is priced at £430 (£599 for UNIX). It is distributed in the UK by Hypersoft (0273 834596).

New R&R

The xBASE edition of R&R Report Writer for Windows (RRW) is now in its second incarnation. The new version addresses a number of the limitations of its predecessor including the lack of a vertical scroll bar, inability to embed bitmaps into reports and no mouse-driven line/box drawing. It additionally provides several new pre-defined functions and page preview options. There's also improved parameter passing in the run-time version. RRW V2.0 costs £199 for a single user. Upgrading from RRW V1.0 will cost £35. R&R is on 0628 788181.

Eiffel on SPARC

Austin-based Tower Technology will be launching its TowerEiffel programming environment at OOPSLA '93 which is being held in Washington DC between September 26th and October 1st 1993. TowerEiffel is an implementation of Eiffel for Sun SPARC platforms which provides a 'tight' C interface, smart recompilation and support for team development projects, distributed applications and commercial library development. The US price is \$1,295 for a single commercial licence (\$345 for personal use). Tower technology is on 0101 512 3286406.

TestCenter

TestCenter is a new UNIX C/C++ development tool from CenterLine for Sun workstations for testing code. It features automatic run-time error checking, memory leak detection on executables and GUI-based batch and regression testing. A scripting language is provided for querying results of multiple test runs. Applications can be tested without recompilation. K2 Software Development (061 7778118) is offering TestCenter at an introductory price of £2,500.

SMS on Windows

SMS, the version control system from IntaSoft is now available under Windows. SMS V4.0 provides both DOS and Windows support 'out-of-the-box'. It comprises tools for version control, configuration management, change management and categorised modification requests. The version control component allows developers to display revision history by name, revision number, creation date, author and purpose. Modification requests are used to assign tasks and track their progress using email. And configuration management offers a mechanism for grouping files and splitting development paths. SMS also provides user-defined report formatting, dependency analysis, a language-independent macro preprocessor and a dependency generator. The single-user version is priced at £490 (5-user is £1180). For a limited time IntaSoft is offering an upgrade from the single-user DOS package for £100 (£200 for multi-user). IntaSoft is on 0392 217670.

Install-o-gram

InstallShield V2.0 is the latest version of the install program development kit

from Illinois-based Stirling Technologies. Unlike some installation toolkits available which are based on C libraries, InstallShield doesn't require a knowledge of C. Instead, Stirling has provided its own scripting language. This has been made more comprehensive in V2.0, with the addition of new variable types (Long, Short, List, Pointers, Chars, Structures, Typedefs); local/global variables; enhanced list & array handling functions; procedure/function calls and switch statements and string assignment and concatenation functions. In addition, developers can now include multiple script files. Stirling claims V2.0 is significantly faster than its predecessor.

There is now support for Windows 3.1, with functions to add, delete, enumerate and modify ProgMan groups and items. Stirling has also included version-checking and functions for maintaining registration databases. Other features include improved file compression/decompression, support for calling DLLs, customisable status bar and, according to Stirling, 'more intelligent, safe updating' of AUTOEXEC.BAT/CONFIG.SYS files.

The UK distributor is Systemstar Software Tools (0992 500919). InstallShield is priced at £295.

32-Bit Visual C++

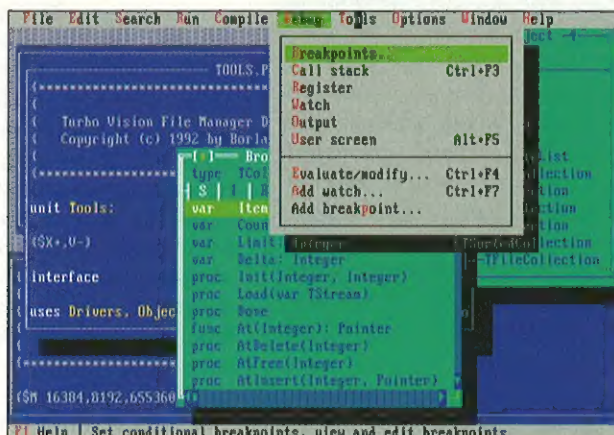
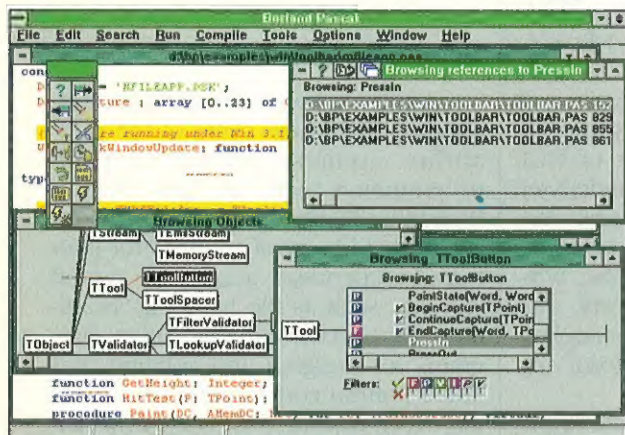
Microsoft's new NT-hosted C++ compiler, Visual C++ 32-bit Edition (VC4NT), is now available. The company has thoughtfully decided to do away with the impressive stack of diskettes from Visual C++ installations; instead it has opted for the single CD-ROM favoured by SunSoft. Printed docs have gone as well: all 9000 pages worth are on the CD-ROM. As a result, the complete, boxed VC4NT is a featherweight at 500 grams. However it is a big package. Remember when you first installed VC++, and ran CHKDSK: 50 MB gone. Well VC4NT is even larger, needing at least 80 MB for a complete installation; although this can be cut down to 6 MB by running the compiler from the CD-ROM.

VC4NT has a similar suite of tools to VC++. So there are 32-bit versions of MFC V2.0, AppWizard, Class Wizard, AppStudio and Visual Workbench. A number of enhancements have been made to the debugger for debugging NT applications. These include multiple thread support, structured exception handling and a memory window. In addition, Microsoft has included Spy++ with VC4NT, a new tool which displays information on threads, processes and windows in Win32-based applications. Another improvement to VC++ is a grep-like find-in-files facility for performing global searches in multiple source files. Microsoft has also integrated the profiler into the VC4NT Visual Workbench.

Microsoft ships supports for both Win32 (ie NT) and Win32s (Windows 3.1) targets out of the same box. Until the end of October, existing users of VC++ Professional can upgrade for £69. Printed documentation is available separately in two kits priced at £69 each. The first contains the User Guides and Language References; the second provides Win32 and Win32s references. Details are available from the Microsoft Upgrade Centre (081 6148000).

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powerful features include a fast compiler and high-capacity DOS IDE with colour syntax highlighting to make your code easy to read and correct, and unlimited undo/redo. Object Browser™ lets you navigate through your source code with ease, and the on-line hypertext help system provides over 1Mb of help text and copy-and-paste examples. Turbo Pascal 7.0 really is the easiest way to learn object oriented programming for DOS.

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**Brillo Brillig**

Decompile your Clipper 5.x .EXE and .OBJ files using Brillig from APTware. Clipper p-code is converted back into source, and .RMK and .LNK files are generated for rebuilding the application with RMAKE. Along with the ability to extract variable, function and procedure names, Brillig will also format the code and comment procedure and function headers in user-supplied styles. Linker support includes Blinker, RTLink and MS-link. APTware (0491 826060) is offering Brillig at a special introductory price of £169 (usual price £199) until the end of November.

SQL from Clipper

Strike! for DOS is a Clipper add-on which provides Clipper 5.x developers with a way to connect to Gupta SQLBase, Microsoft SQL Server and Oracle using a single API. It costs £395 and is available from QBS Software (081 9944842) and Applied Network Solutions (0276 452064).

NT Graphics Server

Bits Per Second (0273 727119) has introduced an NT version of Graphics Server, the company's graphing and charting DLL. The complete package includes both the NT and Window 3.1 versions of Graphics Server. It is priced at £395. Existing users can upgrade from Graphics Server V2.x for £95.

MKS for OS/2 V2.x

Use UNIX utilities on OS/2 V2.x with V4.2 of the MKS Toolkit. This release offers several new utilities including: *awkc*, an awk compiler for developing standalone awk programs; *make* and *iconv*, for converting from one code set to another. There are 130 in total, all of which have been rewritten for 32-bits. In addition, MKS V4.2 is POSIX-compliant. Grey Matter (0364 654100) is selling MKS V4.2 for £230.

PC-to-Video

Transfer text, graphics and animations from a PC to a VCR/TV with TV Coder, WestPoint Creative's latest video output card. It features a built-in flicker filter and a programmable RGB colour lookup table which can be used for enhancing the picture or generating special effects. TV Coder costs £159. Phone WestPoint Creative on 0734 248590 for details.

New Galaxy

Visix Software has announced release 2 of its Galaxy Application Environment, a cross-platform development environment for creating large-scale, distributed graphical apps. The product is available in both C and C++ versions, and the new release adds a number of new features. Visix comprises a suite of libraries and development tools for building applications which are independent of GUI, networking environment or underlying operating system. The product has also been made more consistent across its supported platforms of UNIX, Mac, Windows, NT, OS/2 and OpenVMS, thus making it easier to take Galaxy applications developed on one platform and run them on another.

Galaxy is aimed at corporate application developers and independent software vendors who build high-end commercial applications and who wish to be able to support multiple platforms, or who suspect/fear

that the platform for which they are currently developing will soon be superseded. Visix can be contacted on 071 8725825. Starting price is £6,700 per developer. There is no run-time licence.

Portable Fortran

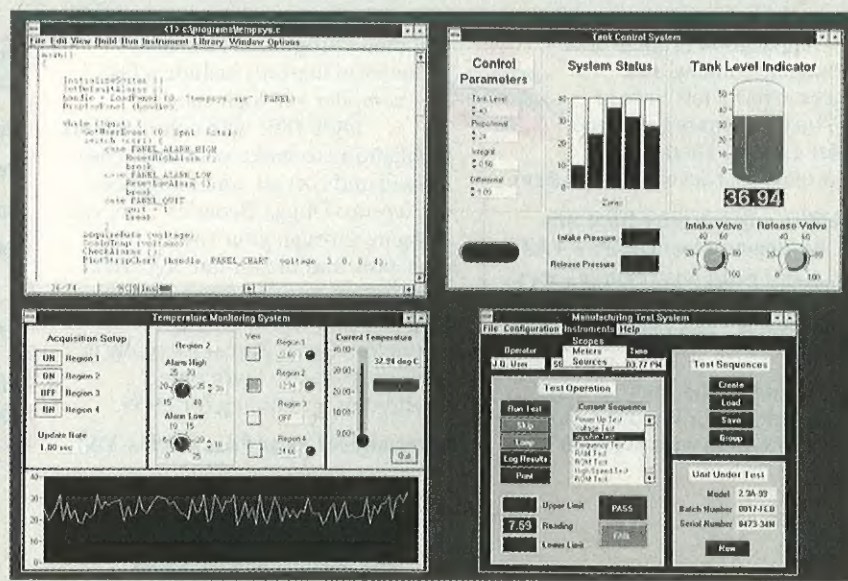
Scientific Software Ltd (SSL) has attempted to address some of the portability issues facing Fortran programmers with its new Fortran Portability Toolkit (FPT). This provides a standard library of routines for platform-independent access to system services, such as file handling. In addition, the toolkit provides utility programs for merging and splitting files and a Fortran coding guidelines manual which discusses the ways in which a program can be made more portable. FPT is available on UNIX and VMS workstations for the introductory price of £450 until the end of November. SSL is on 0491 411727.

Instrumentation Software

National Instruments has launched LabWindows/CVI (C for Virtual Instrumentation), an instrumentation development package that uses ANSI C under Windows and SPARCstations. The software is an automatic code generator designed for engineers and scientists who want to use traditional programming tools for developing instrumentation systems. The development environment includes built-in libraries for performing data acquisition, analysis and presentation, as well as a user interface editor. The system also simplifies the setup and control of the external devices such as GPIB, VXI and RS-232, by providing over 300 ready-to-use drivers for specific instruments.

The Windows version also controls the National Instruments plug-in data acquisition and SCXI signal conditioning hardware.

The analysis library contains over 200 functions for signal processing, filtering, windowing, statistics, curve fitting, interpolation and matrix algebra. Interprocess communication is supported with TCP/IP on the PC and Sun, and via DDE under Windows on a PC. National Instruments is on 0635 523545.



SoftTools for the Job

NEW! NEW!

NEW! NEW!

MEWEL 4.0

Single Source - Multiple Environments

New release of the **MEWEL** user interface library from Magma Software Systems. A library which allows the developer to write a single set of source code for Windows, DOS Graphics, DOS Text, OS/2 and UNIX. MEWEL is an implementation of the Windows API.

MEWEL is particularly recommended for zApp 2.0 and other C++ framework users and for expanding class libraries supplied with compilers.

Price: MEWEL/Text for DOS - £365 - with full source £695
MEWEL/GUI for DOS - £365 - with full source £695

NEW! NEW!

InstallSHIELD v2.0

Latest Release of Installation Program for Graphical Applications. **InstallSHIELD** has become the standard tool for building bullet proof Windows and OS/2 installation programs. A new 1000 page manual describes the many new advanced features including multi-language support. Existing users may upgrade - call for details.

Price: Windows £265 OS/2 £520

MORE SHIELD Development Products

TbxSHIELD

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A toolbox library that allows sophisticated tool box controls to be created quickly and easily.

LogSHIELD

Windows £340 OS/2 £520

A graphical session recording and playback facility.

MemSHIELD

Windows £340 OS/2 £520

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DbxSHIELD

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NOW!	£40
E-MEM	£90
Virt-Win	£235

For Visual Basic

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Dazzle/VB Professional	£375
FinLib/VB	£125
SpellCheck/VB	£55
ProMath	£105
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Telecomm ToolKit	£75

Phar Lap

286DOS Extender

now with support for **Microsoft Visual C++** and includes 286IVMM at **no extra charge**

With the **286DOS Extender** and your Microsoft C, Borland C++ or MS Fortran and now **Microsoft Visual C++** compiler, you have all the tools necessary to quickly build protected mode applications - often by relinking without making source code changes. Protected mode applications can be built that access up to 16 megabytes of memory on any DOS 80286, 386, 386SX or i486 PC. **286DOS Extender** is also compatible with Borland's Turbo Debugger and Microsoft's linker and CodeView debugger. Includes 286IVMM to access Virtual Memory too!

Price: £375

KnowledgeMan

NEW - Release 3.1 from mdb

The latest release of the **KnowledgeMan** fully integrated professional rdbms moves even closer to an event driven GUI environment. Enhancements include Compiler and User-Defined Functions, increased performance, improved system command interface, Optimized Query by Example, new Report Definition Language and Binary Large Objects.

KnowledgeMan capabilities have always gone beyond those of the competition. **Version 3.1 features and enhancements make it even easier to develop applications rapidly and without compromise.**

KnowledgeMan DOS SU - £990, OS/2 SU - £1320

KnowledgeMan DOS LAN - £1990, OS/2 LAN - £2320

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zApp v 2.0 Windows NT	£330
zApp v 2.0 OS/2	£430
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Doc-To-Help	£265
Dolphin C Toolkit	£99
Dolphin Far Memory Manager	£99
Phar Lap 386DOS-Extender	£390

Please check prices at time of order.
Prices do not include VAT or carriage.
All Trademarks Acknowledged.

NEW! NEW!

QUICTURE

Compress Graphics in Word for Windows

Quicture is a unique graphics handling utility for Word for Windows. By using **Quicture** graphics are compressed and off-loaded to disk replacing each one with a placeholder. You can view and print graphics at any time but in draft mode, documents scroll, save and print quickly, taking up less space. From WexTech, the authors of Doc-To-Help.

Price: £75

NEW! NEW!

ISCL

The largest library of C++ Shareware in the World?

Claimed by Image/Soft to be the largest library of public domain and shareware C++ source code in the world. **ISCL** includes the GNU 386 C++ compiler, a comms library, maths and matrix classes, DPMI programming kit, classes for Btreive and Paradox and a C++ library for building GUIs. **ISCL** contains over 100 MBytes of code and is available only on CD-ROM.

Price: £95

Object/Designer

Create Windows applications as if your job depends on it!

Out performing Visual C++, WindowsMaker and Case W, **Object/Designer** enables developers to quickly generate all application source files needed for a Windows application. Includes support for zApp 2.0, Microsoft C++/MFC, Borland C++/Object Windows, Turbo Pascal for Windows and CommonView with instant access to third party editors. The features of **Object/Designer** from Image/Soft make it the only code generation tool flexible enough to be used to write full function Windows applications.

Price: £370

MagnaCharter II

Build flowcharts in minutes!

MagnaCharter II for Windows lets you build any kind of chart in minutes and includes all standard flowcharting symbols which are displayed as icons or add your own. Use the crowsfoot for database schemas. Features are accessed by drop-down menus, dialog boxes and multiple windows with a wide choice of text styles and sizes. Editing is simple 'cut-and-paste'. A wide range of printers is supported as is PostScript.

Price: £190

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**dBASE in Accounts**

Stanford Software has developed *Epsilon*, an accounts package which reads and writes standard dBASE .DBF files. An API is available which documents the database fields and indexes used by *Epsilon*. Stanford suggests that this information can be used by xBASE developers to manipulate accounts from within tools such as FoxPro or Clipper. It includes an example Clipper program. *Epsilon* is priced at £349. Stanford is on 061 4804051.

VBW Shareware

VBasic Library V6.0 is now available from EMS. It is distributed on both diskette or CD-ROM and contains over 425 shareware and public domain Visual Basic programs and utilities. VBasic Library V6.0 costs \$59.50 from EMS (0101 301 9243594).

LPA's VBW interface

LPA 386-Prolog V2.5 now provides direct access to the Windows GDI and a new configurable DDE toolkit for interfacing to Visual Basic. The Programmer Edition costs £745. It includes built-in predicates, development environment, debugger and a DLL interface written in C, C++ or Pascal. The Developer Edition (£1,495) additionally provides a run-time generator. LPA is on 081 8712016.

Superbase price cut

SPC (0344 867100) has cut the price of Superbase V2.0 for Windows. The single-user version is down from £545 to £299. The price of the Developer Edition has also dropped from £950 to £665.

Speaking Paradox

The Paradox Users Group and Richplum Ltd have organised the first European Paradox Conference. It is being held at London's Park Lane Hotel on 22nd and 23rd November 1993. It is aimed at users, developers and supporters of Paradox. Sponsors include Borland, WordPerfect, Dell and Paradox Informant. There will be 30 international speakers and sessions on Paradox for DOS/Windows (both user and programming aspects) and client/server issues. Registration is £495 (15% discount if booked before 15th October). Phone the conference office on 081 3327997 for details.

Add GUI to DOS Apps

MicroMini has introduced V1.4 of GUI Assist, a tool which works in conjunction with VBW to add a Windows-hosted front-end to text-based DOS applications, without requiring access to the original source code. GUI Assist provides a DLL which routes output from the DOS application to VBW forms and traps keyboard input. The Windows-hosted front-end is created using a new utility called GUI Gen. According to the manufacturer, this can generate VBW forms for the front-end automatically, achieved by running the DOS application and recording screen positions/attributes for the various program controls. These are then translated into equivalent VBW controls such as forms, command buttons, text/list boxes etc, along with Click event handlers. The developer is able to modify the user-interface using VBW.

There are two versions of the product. The Professional Edition (£1,500) includes the ability to control multiple DOS applications and comes with an install program for distributing GUI Assist applications. A base version is also available at £350. MicroMini is on 0844 275666.

Insider

A £25 donation to Amnesty International will secure you a copy of Codehigh's Inside Information which normally sells for £95. Inside Information is a PC-based directory of over 6000 PC products (software and hardware) from 2000 manufacturers. Information listed includes manufacturer, telephone number, RRP along with references to reviews/product announcements in the computer press (including a three-year index to .EXE). To receive your copy, send a cheque, payable to Amnesty International, Basingstoke Group, along with a note of your address and the size of diskette you prefer, to Codehigh Ltd, Sedgewell House, Sedgewell Road, Reading RG4 9TA. This offer ends at the end of December.

Blinkety Blink

Blinker V3.0 from Blink Inc provides a Windows linker, a royalty-free 286 DOS extender, a dynamic overlay linker and memory swap function, all from the same package. Features of Blinker include: the facility to link Clipper 5 programs incrementally; up to 16 MB addressable memory and the ability to create applications which will run transparently in protected or real mode. It also includes a compiler-independent virtual memory system which gives up to 64 MB of virtual memory. For Clipper programmers it offers symbol table compression, a profiler and 'burning-in' of environment variables. Blinker V3.0 costs £229. Upgrades from previous releases are available (eg £75 from Blinker 2.x). It is distributed in the UK by QBS Software (081 9944842).

DCE kit for SCO

The DCE Developer's Kit V1.0 from SCO is a suite of tools for developing distributed applications under SCO Open Server and SCO Open Desktop. The kit is an implementation of Release 1.0.2 of DCE from OSF. It provides an application development environment with an Interface Definition Environment (IDL) compiler and header files and run-time libraries to build DCE applications. DCE executives and servers are available for creating all components of DCE including: threads, remote procedure calls, security, cell directory services and distributed time services. The DCE Developer's Kit V1.0 is priced at £4,270 on diskette and £4,100 on tape. SCO is on 0923 816344.

ODBC drivers kit

Now that ODBC has established itself as the Windows API for accessing databases, we should soon begin to see more and more ODBC-aware applications. ODBC drivers for popular databases are available from several vendors. Contemporary Software's new Q+E ODBC Driver Pack provides drivers for over 20 different file formats including Oracle, SQLBase, dBASE, NetWare SQL, SQL Server, Sybase, Informix, DBM, Paradox and XDB. The drivers support all Core and Level 1 ODBC functions, plus a number of Level 2 functions as well. Contemporary says its drivers will work in any ODBC-compliant application including Access V1.1, VBW V3.0 and Lotus 1-2-3 for Windows. The Q+E ODBC Driver Pack is priced at £149.

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Our Visual Basic Programming Course has been fully revised for Version 3.0.

It is a hands-on course with many practical exercises and a supporting case-study which illustrate the practical application of Visual Basic features and functions.

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This is a five day course. The first day is optional for those who already have experience of Windows programming.

THE course for those new to Visual Basic.

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Our 5 day Visual C++ programming course is for developers with a good, current knowledge of C. It provides a thorough and practical introduction to the Visual C++ programming environment, with the emphasis on writing commercial applications.

After the course delegates will:

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All our courses are developed and led by people who are actively involved in the commercial application of software tools. This guarantees that they will understand your needs and the best way to meet your training requirement.

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This introduction to Windows programming covers the most relevant areas in sufficient detail to allow programmers quickly to become efficient in producing applications. By the end of the course students will:

- understand Windows architecture, philosophy and application design considerations
- understand the appropriate use of DDE and DLL's
- be able to make effective use of the available features and functions.

This 5-day course is an invaluable introduction to Windows programming for competent C programmers who already have an appreciation of the Windows graphical interface.

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- Learn how to use advanced facilities; OLE, MDI, MAPI
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- Maximise programming efficiency

If this is what you need to do - we have the course for you.

Delegates need to be competent C programmers with at least three months experience of programming Windows applications, preferably in C/C++. Practicals involve coding in C++.

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Letters

We welcome short letters on any subject that is relevant to software development. Please write to The Editor, .EXE Magazine, 10 Barley Mow Passage, Chiswick, London W4 4PH. Unless your letter is marked 'Not for Publication', it will be considered for inclusion in this section.

A case for JPEG

Sir,
Nice article on Fractal Compression, but there are some points that I felt were absent.

- Fractal Compression is very much slower than JPEG, as is decompression. Special hardware is needed to achieve useful performance - hardware which has a restrictive limit on the overall image size it can handle.
- JPEG technology is public domain, and available free in source form for both compression and decompression. On the other hand, GIF is proprietary, with hefty licence fees.
- While JPEG fidelity certainly degrades quite sharply at the high end of the compression range, a slightly less high compression gives you adequately small files (say 20 KB, instead of 10 KB), with acceptable quality.

Although high compression ratios tend to degrade JPEG picture quality, this compromise is quite acceptable, given my first two points.

Don Milne
Aberdeen

Against Windows

Sir,
Am I paranoid, or is the world getting far too carried away with the Windows phenomenon? Is Windows really that good, or is the whole thing a Microsoft ploy to dominate the corporate desktop with slow, buggy software and copious amounts of hype?

You've heard the standard anti-Windows argument before, about the way that a 640 KB machine with a 20 MB hard disk is now no longer adequate for ordinary use, and that PCs now need 8 MB of RAM and a 100 MB hard disk to run Windows at any reasonable speed. But my experience is that this state of affairs is seriously irritating end users, as well as developers.

Take, as an example, a department that uses PCs to do word processing and a little database work. A couple of years ago, these people would have been

using WordPerfect V5.1 and FoxPro, under MS-DOS, and would have got blindingly fast performance on 640 KB 286-based machines. But the hype generated by Microsoft, and carried on in the pages of all the mainstream computer magazines, have persuaded this department that its machines are hopelessly out of date and that it should upgrade to Word for Windows and FoxPro for Windows. This means upgrading the hardware too, at a hefty cost.

And what do our users get for all this extra effort and money? A system with a pretty user interface but which runs much slower, and is more difficult to use, than what they had before. Still, I'm sure that this is more than offset by the satisfaction that they are keeping up with their competitors and using modern technology.

Go on then, call me a cynical Luddite. I can bear it.

Peter Dawes
Stockport

Nö, Nö, Nö!

Sir,

Now that Will Watts has vacated the Editor's chair, what will happen to the diaseses (as in coördinate) of which Will was so fond? No one else that I have come across uses them, and they are such a typographical oddity that encountering one in the middle of a sentence invariably derails me and I have unnecessary difficulty reading articles in .EXE as a coherent whole. I just can't see that they are necessary. *Coöperation*, *coördinates* and so on are perfectly intelligible and non-distracting without dieresis or hyphen. On rare occasions a discrete hyphen may be necessary but the dieresis just jumps off the page and smacks me round the face saying 'hey, you don't want to read this article - look at me instead!'

Chris Jolly
Text Systems Ltd

Coop or Coöp

Sir,

In defence of the dieresis, I draw on the remarks made by Sir Ernest Gowers

on the subject in *The Complete Plain Words*: 'I have no intention of taking hyphens seriously. Those who wish to do so I leave to Fowler's eleven columns.... For instance, the general practice of hyphenating "co" when it is attached as a prefix to a word beginning with a vowel has always seemed to me absurd, especially as it leads to such possibilities of misunderstanding as unco-ordinated most present to a Scotsman. If it is objected that ambiguity may result, and readers may be puzzled whether coop is something to put a hen in or a profit sharing organisation, this should be removed by a dieresis (coöp) not a hyphen (co-op). That is what a dieresis is for.'

rawkitw@ctx.compulink.co.uk

Right to segment

Sir,

I was amazed, astounded, and generally gobsmacked by the two letters 'Flattening May' on page 10 of the July '93 issue. I'm being attacked for a single throw-away line in my piece about NT. I acknowledged that some people like flat memory, and some people don't. I said I don't like it. That's because I don't.

Contrary to what Mr Henney says, we live in the age of multi-tasking, multiple stacks, multiple heaps and overlays; it's called Windows. Why shouldn't I use such things in my programs? Microsoft is abandoning segments just as the hardware was reaching a point where segments were genuinely useful. That deprives both him and me of options.

Messrs Henney and Collins; if you like flat memory, please feel free to use Win32s or a Macintosh (or even, if you must, NT). But, where do you get off telling me I have no right to like segments?

Jules May

Letter of the Month

The writer of the best letter of the month, as judged by the Editor, will receive a .EXE disk of his choice. The best letter is the one printed first. Please note that letters submitted to this page may be edited.

NEW!
4.0 GUI Version

MEWEL API is compatible with the Microsoft Windows API. This means that from a single set of Windows source code, both a Windows and a **MEWEL**-based program can be generated just by recompiling and relinking with the appropriate libraries and header files. With **MEWEL** a Windows program can be extended to any supported environment - currently DOS text and graphics, OS/2 and UNIX.

When using any other cross platform tool you are locked into a proprietary API. **MEWEL** uses the industry standard Windows API.

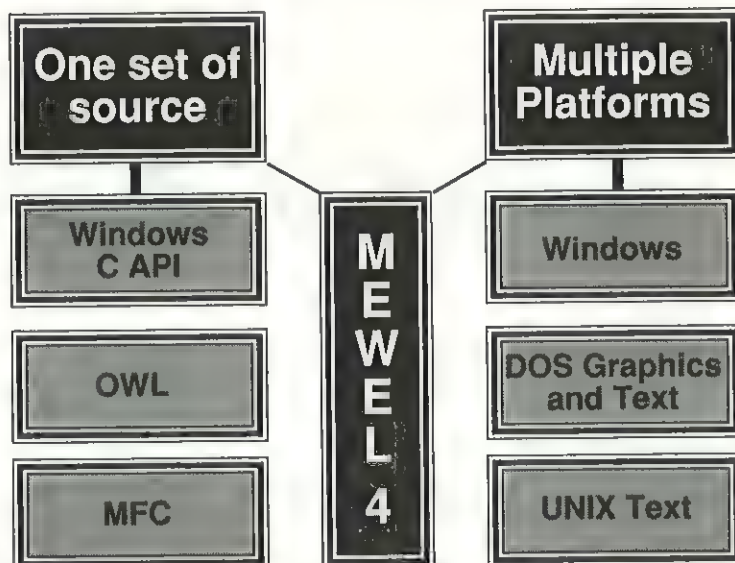
For C++ programmers, **MEWEL** extends the popular Borland OWL and Microsoft Foundation Classes so that they produce DOS graphics and text applications.

If you have a Windows application and need DOS, **MEWEL** will provide a GUI which is **100% code compatible**.

DOS programmers will find in **MEWEL** all the window objects found in Microsoft Windows - multiple, overlapping, re-sizeable windows, dialog boxes, single and multiple edit fields, listboxes, push buttons, radio buttons, check boxes, scroll bars, combo bars, static text, icons, bitmaps, multiple fonts, multi-level menus, mouse and much more.

MEWEL 4.0 from Magma Systems is distributed and supported in the UK by Systemstar SoftTools. Full source code is available. Call for update information from earlier releases.

MEWEL Interface Library



MEWEL from Magma Systems - now available from and supported by Systemstar SoftTools Ltd

Call: (0992) 500919 for more information and a demonstration disk.



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Doc-to-Help synthesizes the desktop publishing capabilities of Word for Windows with the hypertext resources of the Microsoft Help Compiler to create a complete information delivery system that is fast, flexible and completely adaptable to individual needs.

Doc-to-Help is written by WexTech and was awarded the Win100 prize by the US Windows Magazine in the February 1993 edition. In the same issue, **Doc-to-Help** was given the editors choice in a review of leading hypertext tools. The Chairman of the UK Microsoft Users Group has described the product as one of the most exciting that he saw in 1992.

Features of **Doc-To-Help** include:

- Customizable, professionally-formatted document templates.
- Multiple file support.
- Automatic formatting options (for screen shots, captions etc).
- A powerful indexing utility.
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- Easy cross-referencing within the document.

Doc-To-Help is distributed and supported in the UK by Systemstar SoftTools and is available for £265 + VAT.
Call: (0992) 500919 for a demonstration disk.

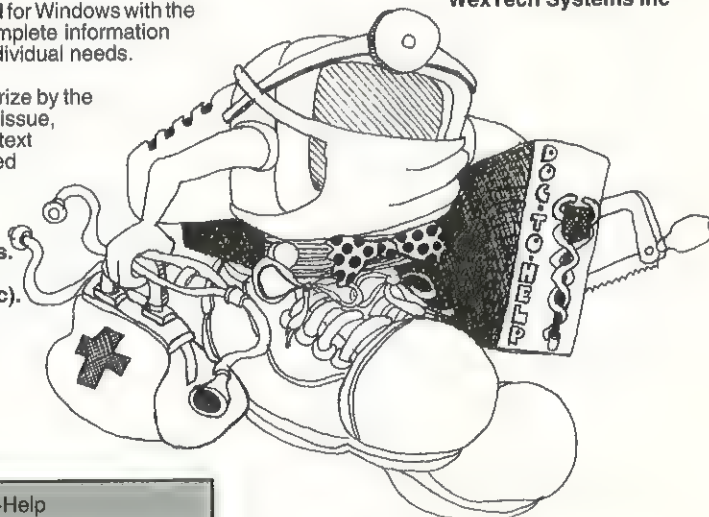
NEW- from the authors of Doc-To-Help
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So what about Aspen?

Just when you thought that CA would never get around to updating Clipper, along comes CA-Visual Objects. But what exactly is it? Robert Schifreen tries to unravel the mystery.

When Computer Associates bought Nantucket, no one knew what it would all mean for the future of Clipper. Would Clipper V6.0 be developed? And what fate would befall Aspen, the OOP version of Clipper that Nantucket had demonstrated at a developer conference shortly before CA got its hands on the company?

As it turned out, things went rather quiet for a year or two. We all assumed that Clipper's development would stop at V5.01, and some of us were beginning to doubt CA's promises that new and good things would soon emerge from CA's Clipper development team.

But just as things were starting to get far too quiet, up pops Visual Objects, a database development environment that can best be summed up as Clipper with Objects. The first version will run under Windows 3.1, with NT and OS/2 versions to follow. Is this Aspen? If not, what is? In the week when Visual Objects went into beta, we spoke to CA to get the full story.

Typical Developers

The company is pushing the product in two major directions. While Visual Objects is 'a natural progression for xBASE users who want to develop Windows applications that benefit from object-oriented programming', it is also being heavily targeted at 'developers of the next generation of applications: mission-critical, financial and transaction processing applications that are the operational backbone of an enterprise.' If you thought that the Clipper group at CA would share the same business goals as Nantucket, think again.

CA seems to be jumping firmly on the objects bandwagon and is heavily promoting the product's ability to product

object-oriented code using the built-in visual tools in VO. Yet research by Microsoft in the US towards the end of last year found that only 15% of VC++ users have seriously committed to using C++ rather than plain C. Has CA gone too far away from procedural code? The company doesn't think so. 'The visual tools in CA-Visual Objects generate object-oriented code. This makes future modifications easier and promotes consistency in user interface design,' it predicts. 'The graphical tools create MDI code automatically; other products do not. Each of the tools interacts with the CA-Visual Objects repository so the relationship between windows, menus, reports, action code and other resources is maintained constantly by the system.'

What exactly is the repository? Traditionally, a make file was needed to control application development. Because the active repository in CA-Visual Objects keeps track of all the relationships between application components, it is said to make building applications much simpler. The repository also provides incremental compilation with entity-level granularity, which means that an individual function may be recompiled instead of a whole file.

Too New?

If you're starting to worry that VO contains too many new features, and will require you to change the way that you program, then don't. Visual Objects supports both procedural and object-oriented programming concepts. It is the first major business application development language with this capability, says CA, conveniently forgetting Visual C++ (although anyone who hasn't seen the class libraries and templates could argue that this is not an application development language). Mixing

procedural and object-oriented programming allows developers to port legacy applications, thus helping CA sell more into corporate sites.

Native Compiler

Visual Objects is, says CA, a true compiler, producing native 80x86 code rather than tokenised, interpreted routines. VO uses both native- and P-code, so developers can mix rigorous and loose programming practices, even within the same function. This means developers can continue to work as they have, while gradually tightening up their code.

Clipper for Windows

Although CA-Visual Objects will take CA-Clipper programs and run them under Windows, says CA, that is only one facet of this 'robust application development environment.' So what happened to Aspen? CA says that indeed it is. Or at least, it's the result of the Aspen project, which provided some of the key technologies. CA has added other major components, such as visual development tools, class libraries and SQL access.

Competitors

What products are going to compete with VO? Presumably FoxPro and dBASE for Windows? Yes, concedes CA, but 'only to a limited degree'. FoxPro is not object-oriented, and neither product generates native machine code. This, says CA, coupled with the extensive class libraries and client/server support, sets VO apart. We'll have to wait and see whether this is indeed true - FoxPro is blindingly fast, native code or no native code.

EXE

Geoffrey!

Has someone deleted your copy of Underpants?

Well, no, I cleared it off my hard disk, actually. Didn't seem any point in keeping it, now that most of my work is in Windows. I use  for Windows all the time these days.

Sounds like a rash decision, my son. I bet you'll miss your multiple buffers, configurable keyboard, C-like macro whatsit, undo/redo, multiple compiler support, templates, smart indenting.

This is the 1990s, Brian. Any half-decent programmer's editor does all that stuff. I use ED for the extras: like colour syntax highlighting...

You what?

You Know.

Very pretty. I suppose it does any language, as long as it's C++?

```
char * title = "Warning!",  
      buf[10];  
// pulls in dialog values  
GetSearchStr(buf);  
if (SQLSearch(db,buf))  
{  
    int MessageBox(this, "Seal
```

Au Contraire. It'll do any language, as long as it's not APL. And you can define your own keywords. Look: I've got the Windows API set up, plus Jim's COBOL library.

Talking of `SQLSearch(db,buf)`, could you load the source?

I'm not sure, but I think you'll find it in

U:\PDS\JIM\UPDATE\LIBSORCE\...

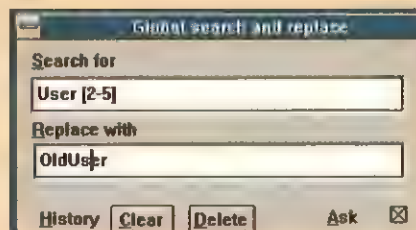
- Stewth! how did you manage that?

```
// C Interface for COBOL  
  
// Implementation of SQLSearch  
// Last modified Jim 2/9/93  
int SQLSearch(DB* view, char *  
{  
    // Searches view database for
```

Just right-button clicked on the function name. ED remembers where all your functions live.

Hmm. Still, you can't beat good old grep...

...unless you want to do a multi-file search and replace...



Sounds more like a jukebox than an editor. How long did it take you to master this ED thing?

That was the best part. ED is a smart editor: smart enough to work the way you do. Which mention of work reminds me: what was it you wanted, Brian?

extensive colour syntax highlighting, smart language sensitive editing for all popular languages, code templates and completion, hypertext function lookup, bracket and object matching, compiler support with error tracking, emulates popular editors, named keyboard macros, regular expression search and replace, search files across all drives and directories (grep), file comparison, unlimited do and redo, context sensitive Windows SDK help, fast C extension language, LAN file-locking, printing with font selection, column and stream blocks, ruler, line drawing, multiple windows + files + buffers, comment alignment, Windows toolbar

Ed for Windows retails at £145. Ed for DOS retails at £99. ED for Windows with ED for DOS costs £199

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A marriage across generations

*Clarion's 4GL incorporates compiler technology from JPI.
Philip McNulty gives his first impressions.*

Clarion products, particularly Clarion Personal Developer for PCs are well-known and popular on the other side of The Pond, but have been fairly invisible here. After the recent merger of Jensen & Partners with Clarion Software in 1992, all that may be about to change. Clarion Database Developer V3.0 (CDD) is a database program/applications generator that combines traditional 4GL features such as extensive database support with native 80x86 code compiler technology from JPI. Although CDD is only available under DOS, Clarion has assured me that versions for OS/2 and Windows 3.x are well in-hand.

File Formats

CDD provides out-of-the-box support for Novell's Btrieve, Clarion, dBASE III/IV, Paradox V3.5, FoxPro V2.0, ASCII flat files and Basic. According to Clarion, drivers for C-tree, Clipper, Netware SQL, Oracle and SQL Server will be available before the end of the year. Clarion has also

developed its own database format (although Btrieve seems to be the default engine unless you select another option). It is multi-user, clearly

Clarion Database Developer combines a traditional 4GL with compiler technology from JPI

groomed for Client-Server applications. However it lacks a SQL interface at present.

The back-end file drivers give considerable DBMS independence and do not restrict, in any way, multi-user

access to the supported databases. All may be freely distributed without runtime licences. I have only tried the Btrieve and FoxPro database drivers shipped with CDD. Not all the features of Clarion are available on all networks, and some DBMSs are, of course, inherently single-user; dBASE III, for example. What Clarion provides is a single 4GL and procedural language interface to a wide variety and growing number of database file structures.

Clarion appears to be moving steadily away from its single-user xBASE origins to the new world of Client-Server architectures (Oracle and SQL Server being due by the end of the year).

Working in CDD

As you'd expect, CDD is project-based. There are two main components: a data dictionary editor which defines tables used in the application and the relationships between them, and an application generator with screen painters, report designers and menu builders for creating the program. The first thing you'll notice when CDD is run, is the IDE, with a menu bar for selecting various tools, invoking online Help and opening/building projects. The mouse cursor is of the smooth variety; this despite being run in DOS text-mode (for an example see Dave Mansell's *A Mouse's Tail* article, *EXE* August '93). Furthermore, Clarion has defined intricate bitmapped radio buttons and check boxes which bear a striking resemblance to their GUI-based cousins.

As a labour-saving device alone, a good data dictionary is worth many

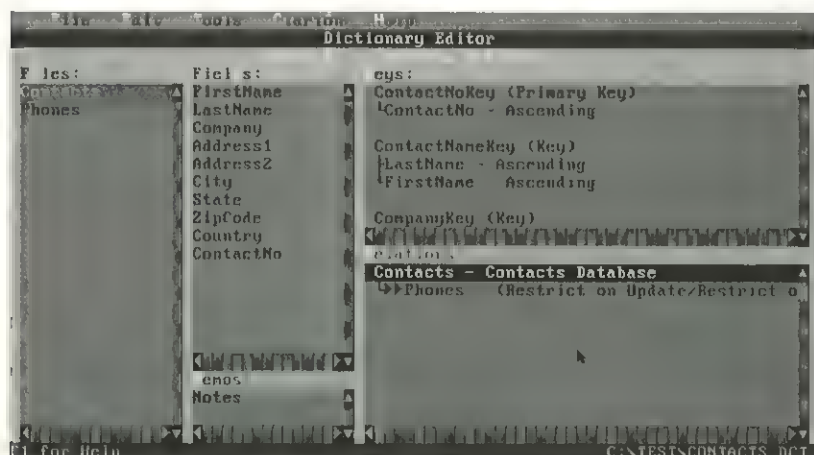


Figure 1 - The Data Dictionary editor

man-weeks of tedious error-prone work in database design and construction. The screen shot in Figure 1 shows Clarion's dictionary editor. It is divided into five areas (or worksheets in Clarion terminology) - File, Field, Key, Memo and Relation. To add a new table a developer simply supplies a new file name in the File worksheet then proceeds by specifying its fields (data type, format string etc).

One surprising feature of Clarion's dictionary editor is in the area of database consistency and integrity checking. You can choose between three automatic ways of ensuring how relational integrity is maintained in an application when primary keys are changed or deleted. You can prohibit the action, allow the action to cascade through all secondary files where the key appears as a foreign key, or you can automatically cause a null value to be set to the foreign key. Developers coming from a SQL background expect this, but coming from xBASE and Btrieve, it's a real bonus. Especially since it would have been necessary to hand-code integrity checking into such applications.

There is one particular productivity tool I for one would like to have seen complementing the dictionary editor. We have over 30 FoxPro DBFs on my present project. I don't relish the thought of typing these file/index definitions by hand into the Clarion data dictionary. So a utility program that will reverse engineer a DD from FoxPro DBF definitions would be nice. Checking the dictionary for relational normalisation etc would then be a small part of the task.

Once the data dictionary has been created, the next stage is the application's procedures, screens and menus. For this, it is necessary to bring up the application generator. Here you specify the name of a template file which CDD will use to generate code, and the data dictionary you have previously created. Any Clarion application must have a main procedure as a starting point for the application. This procedure will form the basis of the menu system or main screen in the application. A screen shot of the application generator is given in Figure 2.

Clarion 4GL

The front-end to CDD is a powerful data dictionary-driven 4GL which

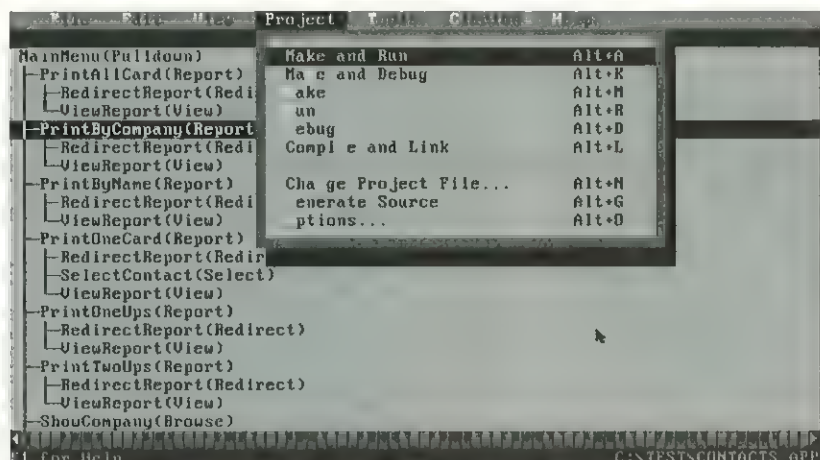


Figure 2 - The Application Generator

generates Clarion source code. You can also add your own handwritten Clarion code, or you can write 3GL code in any of the Topspeed languages - Modula 2, C, Pascal or C++.

The heart of the 4GL is a metalanguage version of Clarion implemented as a set of procedural templates. The 10 templates provided with the package enable most basic database retrieve, update and browse functions to be created for an application without writing a line of code. Templates are also available from third party developers, so you can buy them in the same way that you can buy C++ Class libraries. Well, I'm no greater believer in re-inventing wheels, and buying source code metalanguage templates is as good a way of boosting programmer productivity as any. For a business-oriented language, metalanguage templates look a lot less intimidating to learn than mastering the OOP features of a language like C++.

The 4GL is a little more complete than the equivalent FoxPro Screen Generator. FoxPro provides only a System Menu generator and the Screen Generator, which, although very good, link with absolutely nothing else automatically. Clarion provides full menus, screen painter and report generator.

Clarion screens are also CUA/SAA compliant. This is an attractive feature for contractors like myself who frequently work in several different operating environments where we need to implement a single consistent end-user interface on projects. My latest fax from Clarion announced a new GUI kit to allow CDD users to mimic X-Windows.

The Clarion Language

At first, I wasn't too wildly excited by the thought of having to learn a new programming language, but I found Clarion particularly pleasant. The statements, which are wordy, are mainly related to screen definitions. Like FoxPro's Screen Generator, the trick is to let the 4GL handle the tedious bits and use your skill in writing the start and end procedures linked to field or screen entry/exit processing. Following this approach, I was able to produce reasonably good Clarion code after only seven days' practice.

Superficially a Clarion program looks like a hybrid between COBOL and Modula-2. Impossible to imagine? In fact, the Clarion design team have come up with a pretty good fusion of both languages. Figure 3 lists a few skeletal snippets just to give you a flavour.

Notice that MYPROG2 was announced as being a separate MODULE in the MAP prelude of a program. Each module has a structure such as:

```
! a member of the
! main module
MEMBER('XYZPROG')

Proc2 PROCEDURE
    CODE
! end of procedure
END
! end of XYZPROG
END
```

The map part of a program describes all the modules related to this program. After the end of the MAP section, the user can declare data variables until the word CODE is reached. Everything then to the last END statement is program code.

Now perhaps the relation to Cobol is a little clearer. The left-hand side of the page starting in column 1 are labels which are used to name procedures or variables. The indented column, where reserved names or data names begin, can be any column after the first. Also, the word `CODE` indicates the separation between what would be known as the `DATA` and `PROCEDURE DIVISIONS`. It is possible to use a full stop (.) where an `END` should occur but, personally, I prefer to see the word `END`.

Another Cobol feature inherited is the `GROUP` (ie unions in C). In Cobol, aliasing a memory area to another data structure is known as `REDEFINITION` expressed in the `DATA DIVISION` by a clause such as `B REDEFINES A`. Union declarations in C or record variants in Modula-2 and Pascal may be a bit more elegant from a coding viewpoint, but the way it is implemented in Clarion is geared towards report formatting and aliasing fixed-length strings: a feature which is best handled by the 4GL.

I have noticed the lack of one feature missing in the language: some form of generically independent query/filter facility to extract record subsets for local manipulation/reporting etc. The database filter facility allows one to set simple range checks, but I tried entering wildcards which it definitely didn't like. I have implemented an Informix style of filter using wildcards and range queries under FoxPro. It is a lot simpler than an RQBE method of entering queries; it is totally generic and the users can work through their standard input screens.

At present Clarion's proprietary language may seem a disadvantage. But I am rapidly coming to the conclusion that

```

PROGRAM
MAP
    Proc1

    MODULE('XYZPROG')
    Proc2
    END
END
CODE
    ! here is the main body of code
PROC1 PROCEDURE
CODE
    ! more code
END !end of procedure
END

```

Figure 3 -
Hybrid Cobol & Modula-2

A Sycero Developer speaks...

Two years after I founded Newenden Associates in 1986, we made the move to Sycero dB as our primary Clipper development environment. We wanted a tool to speed up the generation of 'standard' screen, report and file handling code, and to assist with structuring and documenting projects. We decided on Sycero because it handled all these functions, was data dictionary-based, and was flexible enough to handle hand structured and coded programs where necessary.

The applications we've written under Sycero range from simple management systems running on small peer-to-peer LANs up to multi-site point of sale ticketing systems used by several large ferry operators around the UK. The ticketing systems control millions of pounds of revenue per annum and need to be reliable; using Sycero, we were able to develop them within budgets and timescales that would not have been achievable by hand-coding alone. Detractors from application generators often accuse them of inflexibility, but Sycero has proved capable of handling our requirements without causing any significant problems of this sort. Incorporating other Clipper code (written in-house or from third party libraries) is generally just as easy from within Sycero as in native Clipper.

Particularly important to a small software house is the consistency of coding which application generators can be used to encourage. Contract programmers are used for large projects, and Sycero has enabled Newenden to impose sufficient structure on contractors' coding to enable in-house staff to maintain it easily in the future.

What have been the problems? With Sycero dB, very few. Programs are slightly larger than they could be if optimised by hand, and there have been a very few occasions under older versions of Sycero where we've manually needed to tweak the generated Clipper code. A major gripe has been the long wait for V3.0 with full Clipper V5.0 support and features such as user-definable program templates, available in Sycero C for a long while. We have found Sycero's technical support to be very good. Minor updates and bug fixes have been provided promptly when required.

At Newenden, we have also used the C-generating Sycero C which, while excellent in concept, has not been problem-free in use. The very nature of the product makes it much slower at generating code than Sycero dB, and we've encountered several time consuming problems (eg with C memory allocation and deallocation - which had never been an issue under Clipper). Paradoxically, incorporating functions from external C libraries for serial I/O etc has proved very straightforward. The finished applications work well and are robust, but the main benefits of Sycero C will only be felt by those developing for UNIX and Xenix, as well as DOS.

Chris Moore
Newenden Associates
Email: cmoore@cix.compulink.co.uk

it could prove a winning card long-term. Clarion is simple to learn, and the difficult bits are so well handled by the 4GL that hand-coding them will appeal only to total masochists.

Visual Debugger

VID is the source-level debugger which JPI used to ship with its compiler family of products (see Figure 4). You can set breakpoints, run trace, disassemble source code, set watch windows - all from popup menus with hotkeys. Well, I can't remember every use of F4 in life so popup menus are great *aides memoire*!

Graphics Mode

Clarion has a whole list of in-built goodies which work under SVGA. The company has provided a powerful means of incorporating .PCX or .GIF images within your database and screen designs. Screens can be defined to be larger than their physical size: you can pan and scroll a screen by

simply moving the mouse. Clarion also sent me a copy of its VGA kit for customising screen colours. Before that arrived my Clarion screens looked like a David Hockney painting.

The Clarion API interface

By virtue of the fact that Clarion is written using the TopSpeed compiler technology, interfacing code written in TopSpeed C, C++, Pascal or Modula-2 (my favourite) is very easy. The Clarion API kit is primarily aimed at the C language market at present. It comprises header files and a book of advice on do's and don'ts. Compared with the FoxPro/Watcom API, which I found difficult to use, it looks straightforward. The interface for Modula-2 and Pascal users is even simpler than C because neither language relies on header files. You will need a TopSpeed C, C++, Pascal or Modula-2 compiler (ie Borland's or Microsoft's won't do) because all JPI compilers use the same optimising register passing conventions.

CodeBase 5.0

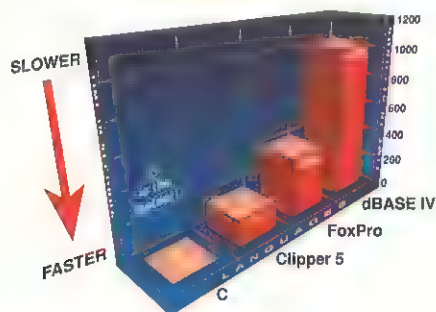
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C speed - fast code, true executables...

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Benchmark for Prime Number Generation
Shows C to be incredibly faster!

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Since JPI had a number of cross-company agreements with several companies marketing C and Modula-2 libraries, the API kit provides CDD users with a vast range of third-party tools and application add-ons. For example, we are using the Greenleaf Comms libraries on my present project.

Docs & Help

Clarion comes with six manuals: *Tutorial*, *User's Guide*, *Programmer's Guide*, *Language Reference*, *Template Language Reference Manual* and the inevitable *Late Breaking News*. The manuals are clearly written and very informative but would benefit from some slight restructuring for the benefit of beginners. There must have been a host of callable library routines, but I wasn't able to spot where in the text you could call well-known functions like `Match(s1, s2)` (used to process a wildcard match against a data field in a browse statement). At least by linking in my Modula-2 libraries I will have access to such useful goodies.

The online Help feature is very good, but perhaps not quite as inspired as FoxPro's. In particular it would be a great bonus if the syntax of each Clarion statement could be shown as it is in FoxPro. That will do a lot for programmer productivity when learning Clarion. For instance, although you can rely on the 4GL to do most of the work for you, on statements such as the `SCREEN` statement, hand-coding is not trivial.

Not only is the 4GL front-end comprehensive, and capable of delivering complete applications, it is also

accompanied by a pretty comprehensive tutorial. I would recommend you allow at least two full days to work your way through the tutorial completely, since it goes through most of the 4GL features very thoroughly. You can stop at any stage you want and continue later. I also think that software companies like Clarion should

**Remember:
dBASE was once
a proprietary
language under
CP/M, but it
hit the market
at the right
moment**

take a leaf out Corel Draw's book and produce a video to accompany product tutorials (although Corel's was badly done).

System Configuration

Clarion requires at least an 80286 CPU, 2Mb RAM, DOS V3.3 (or above). I would suggest that it needs at least a 60Mb hard disk if the development machine is also going to run the applications. Installation is from five 3.5" 1.44 MB diskettes. The full system takes up 14 MB of disk space. However it is possible to specify which chunks of CDD to install.

Conclusions

Clarion is a very powerful 4GL database application generator and language which is fairly uniquely positioned in the market by being able to support multiple databases. It permits more than one type of database to be opened concurrently in an application. First impressions are that Clarion is fast and efficient. I'm using a 25 MHz, 4MB RAM 386 DX PC clone of somewhat uncertain pedigree, so my word is hardly authoritative. But the Sieve of Erastosthenes program provided with Clarion ran through produced over 300 prime numbers in 6.2 seconds, faster even than Borland C.

We need to get manufacturer-independent benchmarks on Clarion's overall performance in typical network environments to verify my initial impressions. Database applications performance in LAN-dominated environments is like an iceberg - 90% of the bulk is invisible - lost in the throttling affects of narrow LAN bandwidths and the inevitable I/O bottlenecks of remote servers. But I'm quite prepared to believe that the compiler efficiency is of a high order.

Clarion should appeal to independent developers writing applications software for their customers, and corporate users downsizing their existing applications currently running on mainframe/mini-computers. It should also be an excellent transition tool in managing the process of change to Client-Server architectures.

If Clarion gains the market recognition it deserves, it could become the nearest thing to a *Lingua Franca* in the Client-Server world that Cobol once was in in mainframes. But it first needs to establish its niche in the market before that can occur. Remember that dBASE was once just a proprietary database generator under CP/M; but it hit the market at the right moment. Given a level playing field, it should find an honourable niche in the market for database generators that offer genuine independence from totally proprietary engines.

[EXE]

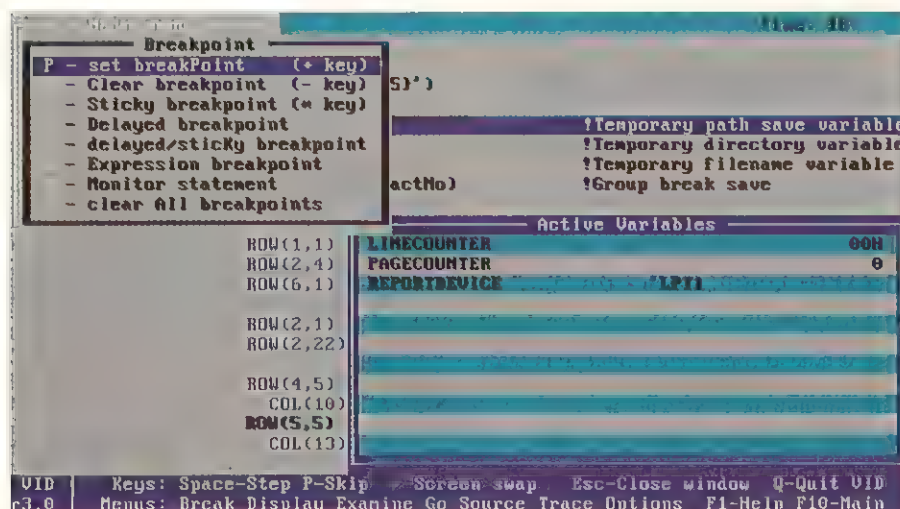


Figure 4 - Debugging with VID

Philip McNulty has been working in computing for over 20 years. He specialises in real time, process control, LANs, and PC networking.

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EXE 10/93

From GLs to GTIs

Patrick McParland discusses the evolution of the 4GL, and why it is time developers took it seriously.

Over the past 20 years, many companies have introduced computer systems to replace tasks previously carried out manually such as payroll packages, stock control systems and simple filing systems etc. Many industries have benefited from this automation of their administrative and manufacturing tasks. Today, this technique is being applied to the computer industry itself: the software industry is trying to automate its main manufacturing task - the development of software - by the introduction of software tools. The vendor hype surrounding these software tools is slowly changing our perception of software development from programming language concerns (ie Generation Languages or GLs) to tool use issues (ie Generations of Tools and their Integration - GTI).

History of GLs

The term GL (or Generation Language) only came into being retrospectively with the wide scale adoption of 3GLs like Cobol and Fortran. Fortran was the first 3GL. It started life in the mid-

1950s. Since that time, virtually all software development has concentrated on the use of a programming language. However, the obsession the software industry has with programming languages has become unhealthy. Developing applications using a purely 3GL approach has the following problems:

- Developers constantly work at the fine-grain level of detail associated with a programming language, making them less likely to generalise the current problem under consideration to produce a piece of code which could be reused in other applications.
- Developers are encouraged to write every application from scratch, believing that, because the low-level detail of their application is unique, then no portion of an application is reusable.
- Large 3GL applications are extremely difficult to maintain because the maintainers are often presented

with a large body of 3GL code without any design information to help them identify the small portion of the code which must be changed.

- To encourage some abstraction away from the narrow confines of programming to the consideration of the end user requirements, development teams are often split into programmers and analysts. Ensuring that the two groups work as a coherent team is a major source of problems in many projects.
- The concentration on low-level programming concerns, the lack of reuse and the need for programmers and analysts, leads to long development times.

However, these problems do not mean that developers should stop using 3GLs. For the development of intricate low-level systems there is no alternative. Since their conception in the 1950s developers have used 3GLs to build increasingly more sophisticated applications. Developers should not abandon this experience. However, the use of software tools can complement the use of 3GLs by increasing productivity, encouraging reuse and helping to control the software development process.

Early Tool Use

Code generators have been available since the 1960s. They are able to infer part, or all of, the code implied by some form of requirements statement. So they would be able to generate a COBOL data division from a data specification. The initial examples were quite basic and received a bad reputation due to quite ludicrous oversell by the vendors - some things never change! One notorious example was called 'The Last One' which implied

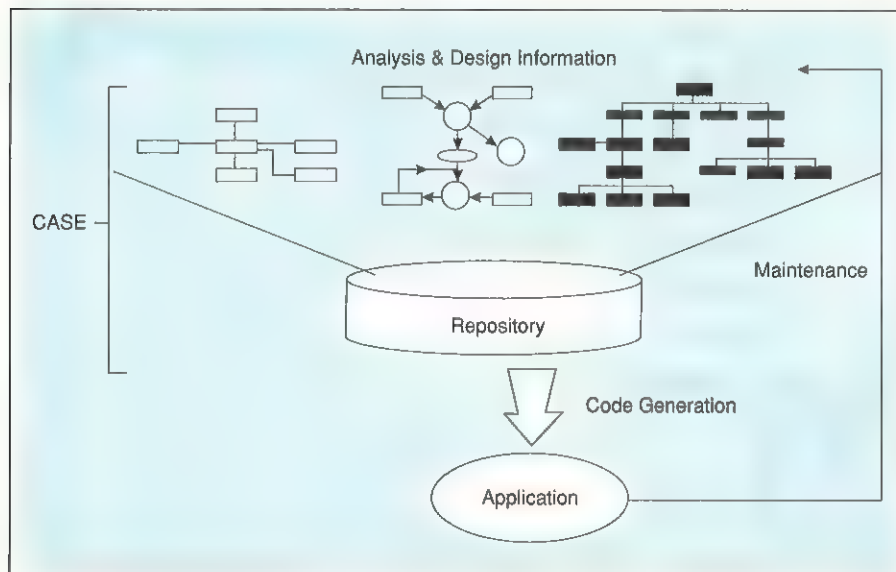


Figure 1 - Relationship between a CASE tool and an Application

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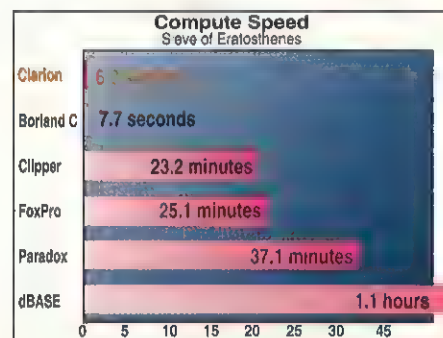
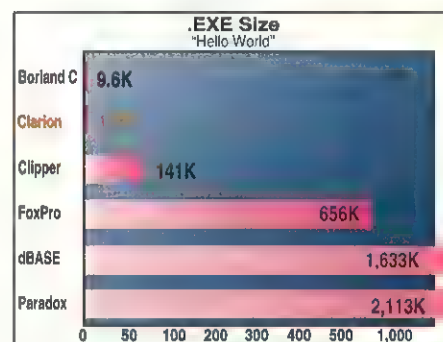
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that it was so comprehensive that it was the last computer program that would ever need to be written.

However, this technology has now matured with the availability of more comprehensive code generators (such as APS and Telon for Cobol applications). These application generators function by reusing the same core design for every application - developers insert the detailed functionality and screens for a particular application. Thus developer concerns migrate away from the need to churn-out low-level code, to more end-user oriented considerations such as the user interface design.

4GLs also use the concepts of code generation and reuse. However, the term 4GL is itself misleading because, unlike a 3GL, a 4GL is not just a programming language but a tool-based development environment. It *does* provide a programming language but this tends to be 3GL in character. 4GLs can provide phenomenal increases in productivity over 3GLs for the development of straightforward information systems.

They help developers to achieve this productivity by providing easy to use code generators for developing screens and reports, and by providing a comprehensive library of verbs, or subroutines, for commonly used program functions. The result is that developers often only need to write code for the most complex processes in an application.

Developers can spend more time ensuring that the screens and the reports they produce meet the end-user's requirements. They can even use the 4GL to produce a prototype which the developer can discuss with the end-users. Thus developers spend less time coding and more time ensuring that the application satisfies the end-user's requirements. In some cases developers spend so little time writing detailed code that the need for separate analysts and programmers disappears.

However, 4GLs are not general purpose software development environments so they are not applicable to all software problems. In fact, some companies have had extremely bad experiences of using 4GLs on the wrong type of problems. 4GLs are excellent for the development of relatively simple information systems.

The New Messiah

If you believe all you hear, then CASE (Computer Aided Software Engineering) tools are the latest, and the best, panacea for all your software development problems. Certainly they offer more support for the software developer than is available using 4GLs or

***One notorious
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to be written!***

code generators. A CASE tool supports a software development method that guides the developer through all stages of an application's development, from planning through to construction.

Moreover, if the CASE tool provides a code generator to automate the construction phase, then the CASE tool can reduce significantly future maintenance problems with your applications. The CASE tool achieves this by maintaining a dynamic relationship between the application's code and its specification (see Figure 1). Developers make all updates to the application via the CASE tool's analysis and design tools and then regenerate the application's code using the code generator. Thus the application's specification is always up-to-date with respect to its code. Applications are easier to maintain when a specification is available.

However, perhaps a CASE tool's biggest aid to software development is the way it encourages developers and maintainers to concentrate their efforts on the analysis and design of an appli-

cation. Instead of spewing out reams and reams of 3GL code, developers concentrate on understanding the end user's needs and then designing an application to satisfy those needs. Constructing the final application has a lower priority since developers can use the code generator to generate a large portion of the code automatically. As a result of this change in emphasis, some companies are dispensing with the need to divide development teams into analysts and programmers.

The use of CASE tools can also encourage reuse by allowing developers to work at the design-level where they can more easily identify common parts of different applications - leading to better code reuse.

Other Tools

Tool use does not stop at the traditional boundaries of CASE technology - analysis, design and construction. They are available for project management, testing, version and configuration management, reverse engineering and many other areas. Future generations of software tools will support the integration of these tools into a single development environment.

There are two main approaches available for developers to achieve the level of integration they require: single vendor I-CASE (Integrated CASE) and C-CASE (Component CASE). Using the I-CASE approach the developers choose a software tool vendor offering an integrated set of tools (i.e. analysis and design tools, code generators and project management tools) and acquires all of these tools. In theory, since all of the tools are from the same vendor, integrating them, to allow free and easy exchanges of information, should not be an issue. The problem with this approach is that no single vendor can provide the best tool support in every field of software development. Therefore, the price of integration can be the use of second class tools in several areas.

With C-CASE, developers select a standard repository (or data dictionary) and acquire tools from a range of vendors who have tools that interface with the repository (see Figure 2). This is the approach advocated by standards bodies, such as ANSI with



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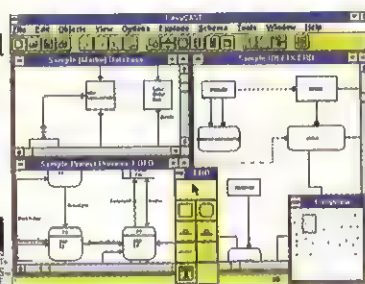


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the IRDS repository, and hardware vendors such as IBM (AD/Cycle), Digital (Cohesion) and ICL. The C-CASE approach would allow developers to choose the best tools available and support their integration in a single development environment with the standard repository at its centre. The problem with this approach is that the sophisticated repositories necessary to support C-CASE are not widely available yet.

Conclusion

Regardless of whether I-CASE or C-CASE becomes popular, a key concept in the 1990s will be the **capitalisation** of software developers. Developers will require the latest workstations with an integrated development environment using the latest software tools. Certainly, one of the easiest ways to increase productivity and quality is to encourage the use of software tools. Software tools

enforce a standard notation and carry out many consistency checks which makes their use a valuable asset in the development of an application. However, introducing a software tool can be non-trivial as it may require major changes in the way a software development organisation operates.

Thus the vendor hype surrounding these new software tools will slowly change our perception of software development from programming concerns to design issues. Vendors are encouraging companies to buy more software tools and so capitalise their software developers. New programming languages will evolve and Cobol and C will live on but vendors will always have a new tool to market.

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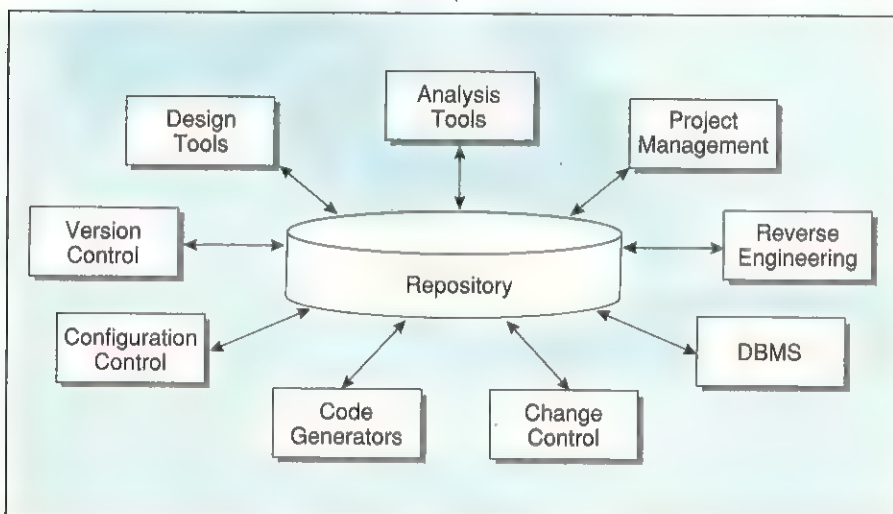


Figure 2 - Integration of software tools with Component CASE

Patrick McParland is a lecturer with the Queen's University of Belfast and also works as a consultant for the software industry. He specialises in the introduction of CASE tools and recently completed a report on the use of CASE tools.

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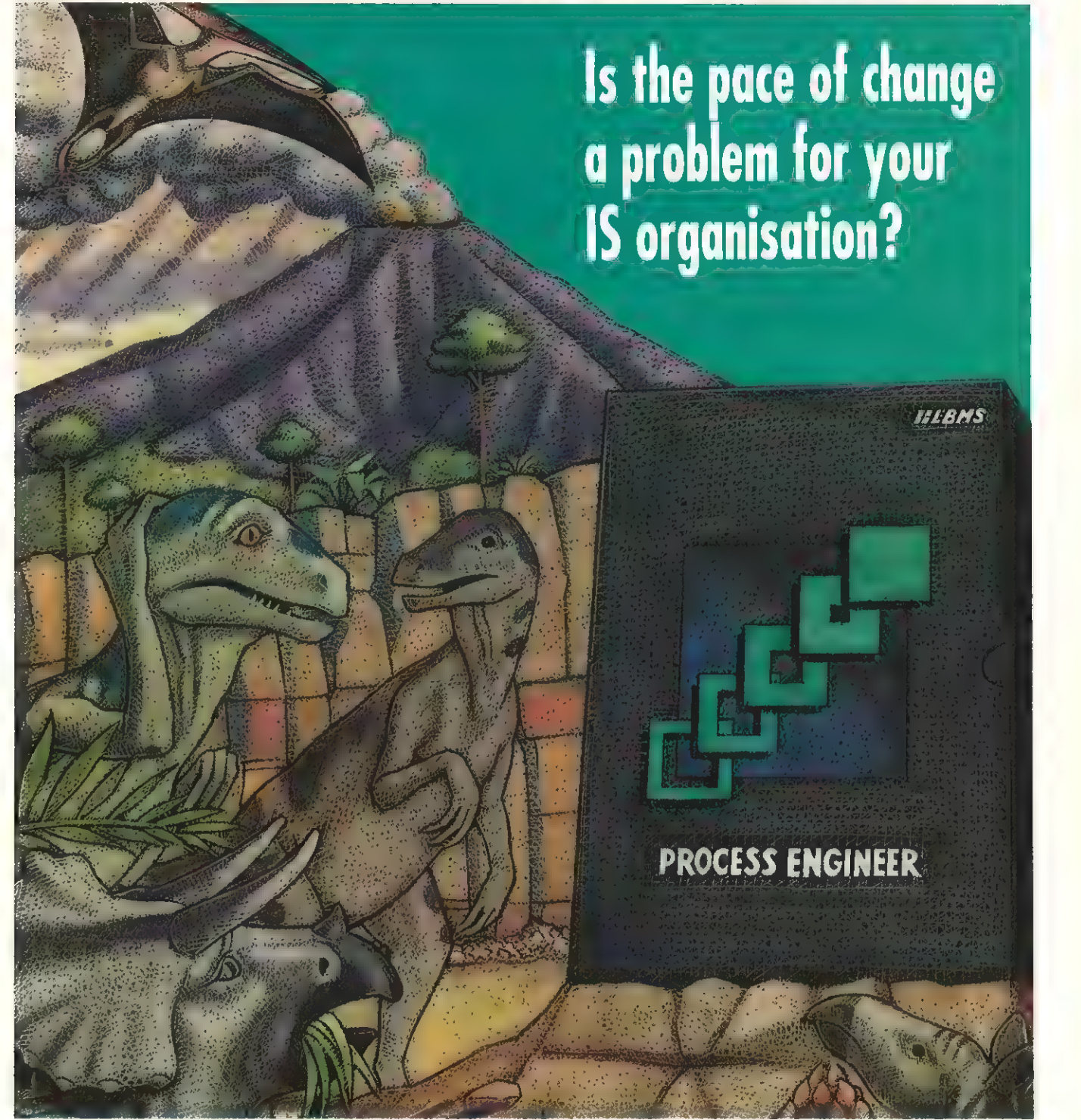


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A prehistoric landscape with dinosaurs and a large computer monitor. In the background, a large volcano rises under a cloudy sky. In the foreground, several dinosaurs are depicted: a T-Rex on the left, a long-necked sauropod in the center, and a Triceratops on the right. A large, dark computer monitor is positioned on the right side of the scene, displaying a green geometric logo and the text 'PROCESS ENGINEER'. The monitor is placed on a rocky surface.

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Overdrawn!

Ian Howells discusses how open standards and GUIs are changing the face of traditional OLTPs.

Online Transaction Processing: the technology that forces your bank account to be debited when a cheque is cleared; that sits behind the 'hole in the wall' Automatic Teller Machine (ATM) insisting you remember your PIN number; that causes the terminals of the stocks/shares/commodities/currency traders to get updated with the most up-to-the-minute information. You'll find OLTP on systems which comprise a large number of users performing a large number of queries on databases with a large number of records.

Batch-processing is unsuitable for many of the applications of OLTP. For instance, if a bank used a batch program run at midnight to update all transactions of the day, your balance may say that you're overdrawn when, in fact, you're in credit. Hence, more and more processing cycles are moving from batch to OLTP. So many businesses need to have their applications based on OLTP technology instead of their current systems.

The move towards Open Systems OLTP has been driven by several large industry trends including decentralisation, rightsizing and the maturing of the open systems server market. In this article I will discuss the need for standards-driven architecture, and the great marketing opportunity which has arisen as a result of wide spread adoption of modern GUIs such as Windows. The reasons to move to GUI-TP and the principles behind it will also be examined.

The Market

Open Systems OLTP is growing rapidly. It is currently estimated to be an industry of a size in the range of \$2.4 to \$4.4 billion. (InfoCorp estimates it will grow to a \$15 billion market by 1996.) Traditional TP environments

were developed for mainframes: consequently, they are 3GL character-based solutions. They were very successful at high performance trans-

Practices correct for the architectures of over a decade ago are still in use today

action processing, but were limited in what facilities could be offered to the user. The advent of the relational DBMS brought with it, not only flexible, data storage and retrieval mechanisms, but also far more productive toolsets. What are now desperately required are powerful, productive tools, now commonplace in the RDBMS industry, that can be used

against modern Open Systems TP monitors. In other words, the best of both worlds - cost-effective performance and flexible, along with state-of-the-art toolsets.

What's it all about

An OLTP is built on large (several gigabytes), shared databases with thousands of users. Queries are usually short and simple ie 'debit my account now'. However, a large number of such queries are processed by the system. Generally, I/O to and from the OLTP is well-defined. For instance, with the ubiquitous cash dispenser (ATM), there are inputs to withdraw cash, find balance, order statement/cheque book etc. It is important that transactions can be 'priority ordered'. When a bank detects fraud, it needs to run the 'shut down system' transaction immediately, and not have to wait for the transaction queue to clear. From the types of application-area which use OLTP it should be obvious that these are 'mission critical' applications. Consequently a high level of reliability is crucial.

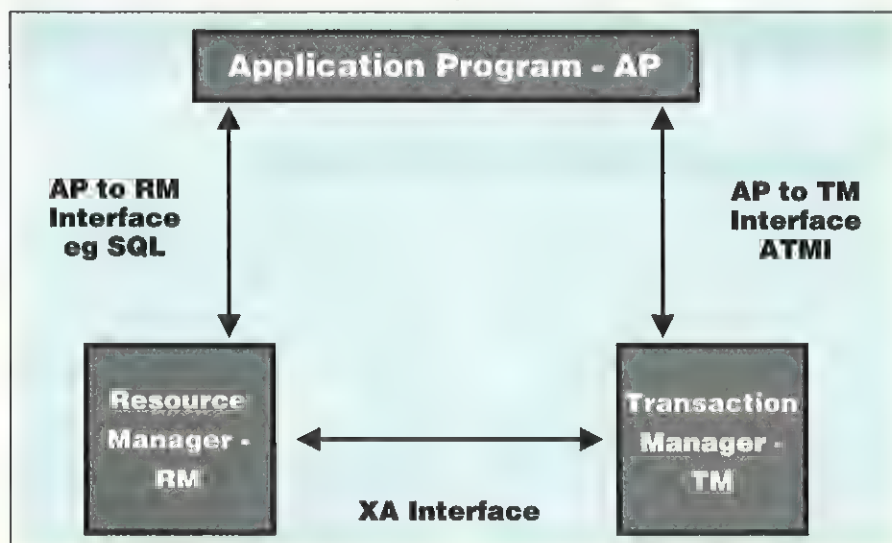


Figure 1 - X/Open Distributed Transaction Processing model

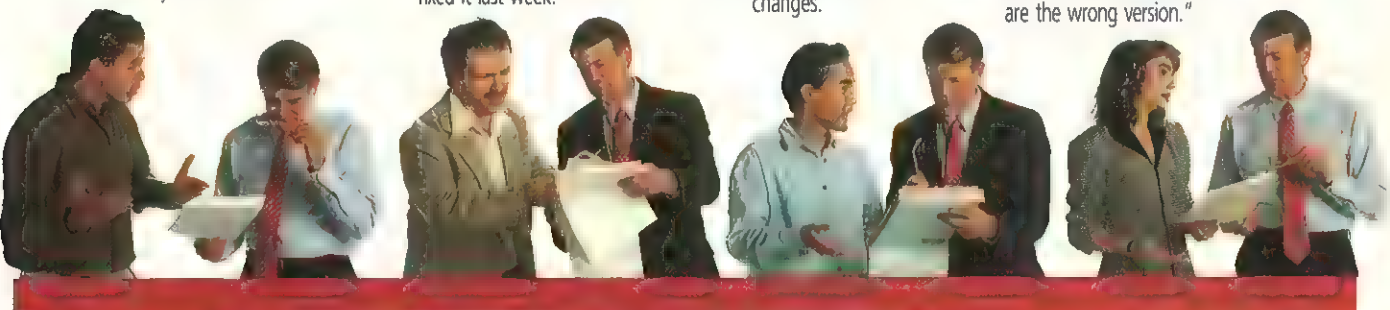
"... So I stayed up all night fixing it, and in the morning Paul saved his version and overwrote all my work."

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OLTP requirements

OLTP has some significant differences to other environments such as decision support, MIS and other low-throughput systems. It is typified by the degree to which it can provide:

- **Data Integrity** - A transaction must have a definite goal. So money can't be taken from *your* account without being put into *mine*.
- **Control** - It should be possible to configure the capacity of transactions processed for different system loads.
- **Recoverability** - It is all very well taking backups, but we also need to restore from backups as quickly as possible: imagine what would happen if a banking system was 'down' for 24 hours.
- **Performance** - Throughput should increase as the number of users on the system increases.
- **Standardisation** - OLTPs are inherently complex. Better to build from non-proprietary components which work together.

Data integrity must be guaranteed by the service provider even in the case of system failures, including hardware failures. Such techniques as disk mirroring, dual ported peripherals and resilient software should be utilised to enable this.

The system administrator should be able to control the system without disturbing running applications. Potential hardware and software must be utilised to provide resilience in the case of failure. Transaction integrity is vital. Remember: the more a company relies on data, the more it should invest in protecting it and maintaining its correctness.

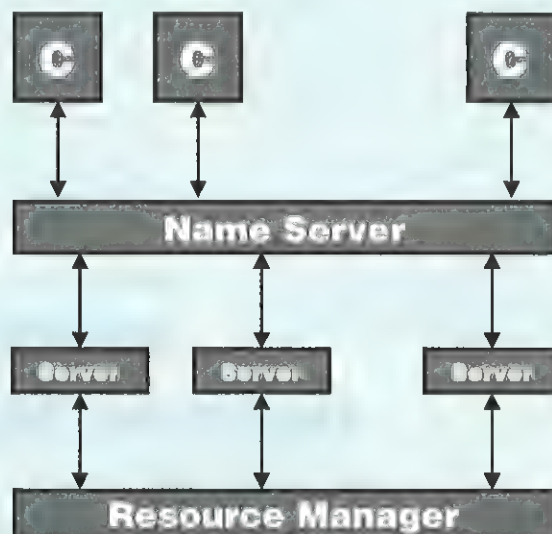
Recovery/backups must occur continuous with the normal running of the system. Applications must not be halted to perform backups. Backups must cause a minimal performance degradation to the system and take place in a reasonable amount of time. Recovery should be rapid. Backups are only taken to facilitate recovery. Hence when recovery is needed the system should return to an on-line state as quickly as is possible.

Performance means a high transaction rate. The system must make efficient use of resources. As the workload increases or as more users are added, an OLTP system's throughput should increase in proportion, without placing

a heavy burden on the operating system. Communication within the system must be minimal, as there is potentially a large volume of inter-process communication which, if not taken into account, could cause a bot-

Enhanced Client/Server Model

- **High performance** - Servers run continuously. There is no startup overhead for a service request.
- **Increased Throughput** - Throughput is increased through continuously running servers and multiple occurrences of services to meet the needs of the application.
- **Location Transparency** - The name server carries location information. Client processes simply request a service by name.
- **Robustness** - Transaction control ensures database consistency. Servers can be restarted or moved to alternate locations as necessary.
- **Flexibility** - Dynamic control enables an administrator to tune the system to fit the traffic. New application functionality can be added without disturbing existing portions.
- **Scalability** - The number of servers or systems can be adjusted according to the needs of the application and the workload.
- **Efficiency** - Resource sharing reduces cost per user. Client processes connect to the name server through the Transaction Manager which provides location transparency (ie the location of the device is immaterial).
- **Interface Transparency** - The location of the processing of the client interface is transparent.
- **Transaction Capture Device Transparency** - The device that captures input is immaterial. Multiple different devices can concurrently be used.
- **Resilience** - Transaction capture device failure has no effect on the rest of the application.
- **Multiplexed Input** - Several Transaction Capture Devices can be combined into one input stream.
- **Smaller Client Processes** - Client processes can utilise a very small amount of memory. Server processes connect to the name server through the Transaction Manager. This provides location transparency (the location of the server process is defined in the configuration files and hence is transparent to the client processes).
- **Administration** - TP monitor facilities aid in system administration.
- **Load Balancing** - Dynamic load balancing can take place across Resource Managers.
- **Server Restriction** - Processing can be arranged by the arrangement of services within servers, by use of priorities or by sending jobs to a background queue.
- **Robustness** - Failure of a single application resource is well contained. Servers can be automatically restarted. Groups of servers can be reallocated to alternative machines in the event of a system becoming unavailable.



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tleneck. The system must be reliable with a high availability. Thus, performance monitoring and management is required to tune the system and optimally use critical resources.

Having examined the requirements at the system, application and service level I will now look at standardisation in greater detail.

Open Standards

Within the new Open Systems TP environment, standards have an important role. If we are to believe what we hear: 'they provide the framework for the future.'

X/Open has been working on defining an Open Distributed Transaction Processing model. The individual components illustrated in Figure 1 make up an X/Open conformant TP system, along with the operating system, database management system and other system facilities.

The Application Program (AP) component defines a transaction and uses resources within transaction boundaries. Each AP specifies a sequence of operations that involves resources such as terminals, (end-user interfaces) and database primitives such as access or update.

A number of Resource Managers (RM) can exist which manage some of the computer's shared resource. Other software entities can request access to the resources using an interface that the RM provides. Examples of RM's are: relational database management systems, Indexed Sequential Access Methods, print servers etc.

The Transaction Manager (TM) takes care of global transactions. This relates to transactions involving more than one RM. To enable this, it monitors the

A transaction must have a definite goal. So money can't be taken from your account without being put into mine

state of the global transaction and performs global failure recovery. Transaction managers can exist on multiple systems, communicating via the Distributed TP (DTP) Protocol. The X/Open Model defines two programming interfaces for the TP application programmer. SQL is used for accessing the database, and the Application Transaction Manager Interface (ATMI) provides an API for invoking the TM from application code.

DTP is a protocol which allows two or more TMs to communicate and distribute information about transactions. XA is the interface between the TM and the RM (DBMS). It is used to send information about the transaction (the transaction id), and to perform the Two Phase Commit (2PC). It is the complete set of protocols that defines

an open standards-based TP environment.

Client/Server

The advantages of client/server architectures, such as scalability, are well known. The enhanced Client/Server architecture improves on the 'basic' model by placing a 'Name Server' between client and server processes, and removing the requirement for each client to have a dedicated server. The advantages of this architecture are listed in the 'Enhanced Client/Server' box.

The relationship of the Client-Server Model to the X/Open Model is shown in Figure 2. As you can see, the application code is divided into two separate application processes, one for the client and one for the server process respectively. The client process handles all of the interaction with the user. For a terminal user this would normally be handling forms and all user I/O. The client code usually defines the start and end of global transactions. The server process handles and controls all access to the resource managers (eg Ingres). The server application code contains all of the SQL statements to access the databases.

The code invoked in a server process by a client is written in the form of a service routine. A server may contain many such service routines. The Name Server routes messages between application processes on one or more systems. Applications may thus be moved from one system to another simply by changing the contents of a configuration file - without altering any of the application code. This can be expanded to support the distribution of an application across multiple systems connected by a network. Data can be partitioned across multiple systems eg surnames A-M and N-Z. An identical Application Service can exist on each machine. The configuration file provides routing information that can direct a request to the appropriate system depending on the value in the data field. In modern environments it will be the enhanced client-server model that will typically be adopted.

Three Tier Example

In Figure 3, the under-the-bonnet standard is XA which dictates standards-based communication between

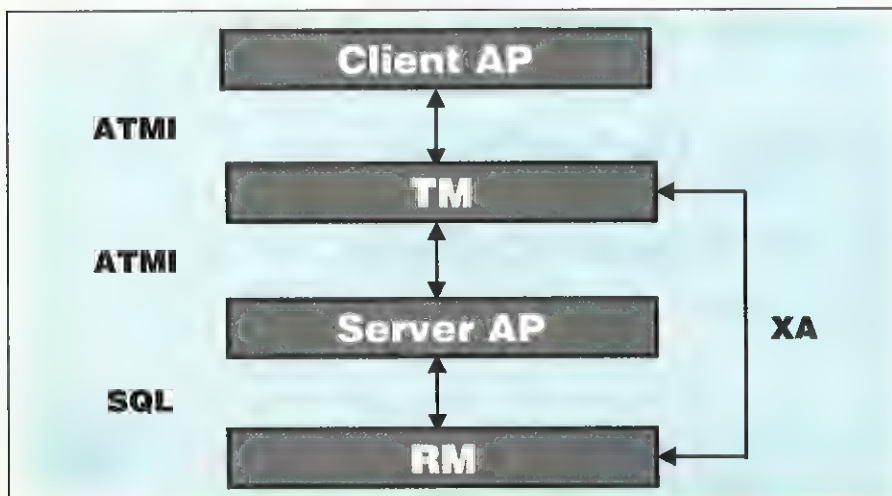


Figure 2 - X/Open DTP Client/Server model

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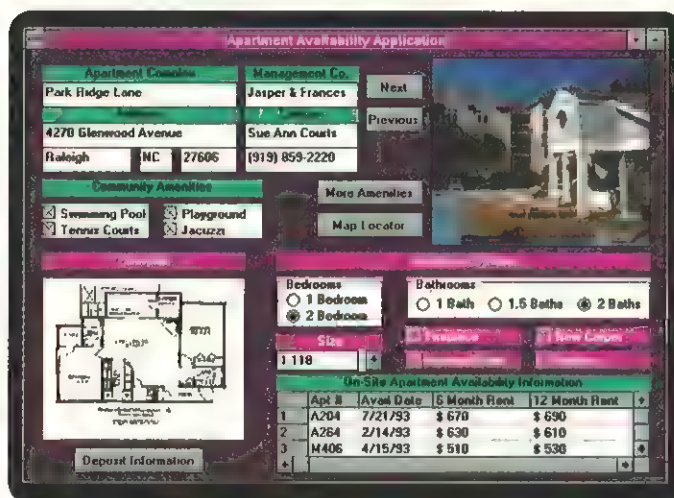
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the transaction manager and the Resource Manager (Ingres). What is far more relevant at the Application Client level is the way you call a service (such as Debit, New or Credit). The major standards defined here by X/Open are the XATMI and TX standards. These are to the client what XA is to the RDBMS.

Role of Windows

Standish predicts that 80% of future OLTP projects will require some form of PC integration. New applications are likely to use a GUI interface. Migration of existing applications may require block-mode terminal emulation. The reason for this upsurge in interest is not immediately apparent. The reasons for GUI-TP are subtly different to those found for typical knowledge workers on a PC - but just as powerful. Traditional TP interfaces were initially developed many years ago. However, practices correct for the architectures of over a decade ago are still in use today, in totally different environments. The traditional system had a large number of terminals. Applications typically had many static forms. Priority was set on minimising interaction with the TP system to reduce network traffic.

Using GUIs, modern client technology allows much more data to be placed on the screen. This output can be dynamic - based on values in fields - and can include new classes of data, such as images. The client can also be used intelligently to cache information. The client is able to store not only the current form, but previous screens too.

Application-specific online help can also be held at the client. Suddenly, practices of twenty years ago are not valid as they no longer require communication to the TP monitor across the network.

When a bank detects fraud, it needs to run the 'shut down system' transaction immediately

The power of this new architecture is fully enabled by adopting new principles to application design. The traditional application on a terminal behaved in a very linear fashion, with as much information crammed onto a form as possible. The power of the new architecture is enabled by using event-driven, object-oriented principles. Already, this change has brought with it major advantages.

Applications have been drastically reduced in size, with as much as a 90% reduction in the number of forms required. Since forms are dynamic they can change in context with what is being displayed. Visual feedback is provided and the context

of forms is preserved ie if you enter a product code on one form and proceed to other forms where the product code is required, you do not have to go back to find out the code (and lose all of the subsequent work you have done). Instead the previous window can be referenced and the value copied and pasted to the other screen. In addition, the GUI offers a way to integrate between disparate systems. For instance it is possible to display all relevant information on a person, such as Current and Deposit account details.

TP Management

Systems management is seen as a key enabling technology for rightsizing. Vendors must provide improved 'people efficiencies' with combined system and network management products that address the 'client' desktop device as well as the distributed server device. TP systems are subsystems in their own right with resource demands and queues. They are ideal candidates for GUI monitoring and management. Through this approach, bottlenecks can far more easily be spotted and appropriate configuration made.

TP Monitors

A number of Open Systems TP monitors exist. The most prominent are Tuxedo (Unix Systems Laboratories/Novell), Encina (Transarc), CICS/6000 (IBM) and Top End (NCR).

Conclusion

Open Systems Distributed Transaction Processing is set to increase the use of the relational database system enormously. TP monitors coöperating effectively with the RDBMS will enable very high throughput, high availability systems to be built across distributed architectures. What is happening is, not one, but a number of technologies are converging together to bring forward large scale open systems distributed data servers.

EXE

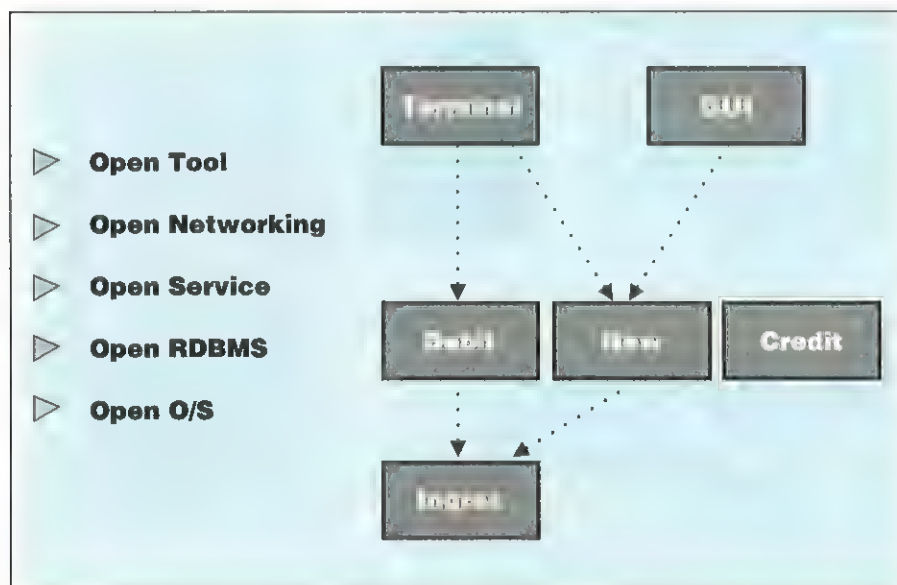


Figure 3 - Open OLTP

Ian Howells is the Product Marketing Manager for Ingres UK (0734 496000). In this role he has been the company representative on the OMG. He regularly speaks at public seminars and edits technical articles.

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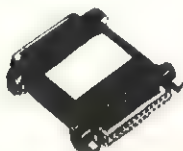
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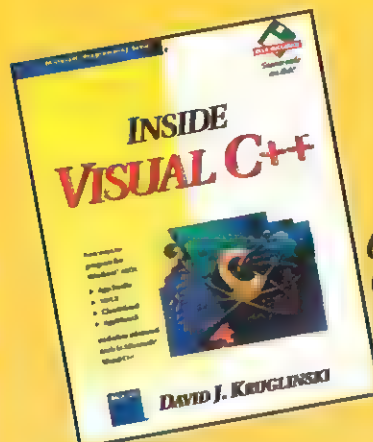
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Fax Finale

In the final part of his series on fax, Andrew Margolis outlines both the EIA Class 1 command set and the T.30 fax session protocol, and ties up a few loose ends.

Last month, I described Class 2 fax modems. I will now end the series with Class 1. The complete EIA/TIA-578 Class 1 command set ought to appeal to minimalists. It is shown in Figure 1, and consists of commands to send or receive data in T.4 fax format and commands to send or receive data in an HDLC frame. These four data handling commands take a parameter which sets the speed and modulation scheme to use (for instance, AT+FTM=96 tells the modem to prepare to send data at 9600 bps using V29 modulation). There are two other commands: one enables you to wait for a specific amount of time - mostly used when changing modulations, and one which waits for silence on the line - for error recovery. You also need to know that the command AT+FCLASS=1

+FTM= Transmit Data
+FRM= Receive Data
+FTH= Transmit with HDLC Framing
+FRH= Receive with HDLC Framing

All the above commands take a parameter indicating the speed and modulation to use as follows:

3=v.21 ch 2 300 bps
24=v.27 ter 2400 bps
48=v.27 ter 4800 bps
72=v.29 7200 bps
96=v.29 9600 bps
145=v.17 14400 bps

Alternatively, the capabilities of the modem can be ascertained using a ? (e.g AT+FTH=?)

+FTS= Stop transmitting and wait
+FRS= Detect Silence and wait

Both the above commands take a parameter indicating the number of 10 ms intervals to wait

Figure 1 - Basic Class 1 fax modem commands

places the modem into the correct mode to send or receive faxes.

The easy part in sending or receiving a fax is squirting out or gobbling up the T.4 data. This is very similar to handling T.4 data with a class 2 fax modem, which we looked at last month. The difficult part is negotiating with the remote fax. All a class 1 fax modem provides you with is the ability to send and receive HDLC data frames. You have to do the work of composing and interpreting these frames yourself. To do this it is essential to know something about the CCITT T.30 recommendation, which describes the five separate and consecutive phases of a Group 3 facsimile transmission. Understanding the technical details of how this works is not only essential if you want to program Class 1 fax modems, but is also required for debugging other fax modem classes and for making sense of much technical documentation. Therefore, a digest of the important parts of the T.30 recommendation follows. As with all the information presented in this series, commercial developers are advised to look up the original.

Phase A

Phase A handles the call set up. Initially, this is much the same as setting

up an ordinary data call, and covers dial tone detection and phone number dialling at the calling station, together with ring detection and call answering at the called station. It only starts getting complicated when the two stations try to identify whether a call is a fax or not.

A calling station optionally identifies itself as a fax by sending a CNG (Calling) tone (1100 Hz in 500 ms pulses at three second intervals), which is the tone you have probably heard when a fax machine calls up on your voice line. During this time, it is also listening for a one second preamble from the answering station comprising a continuous stream of HDLC flag bits (01111110) sent at 300 bps. Once this is detected, the calling fax goes on to Phase B. An answering fax optionally identifies itself 2.15 seconds after answering with a 2100 Hz CED (Called) tone sent for 3.3 seconds and then waits for 75 milliseconds before sending the preamble described above. (All timings $\pm 15\%$).

Though the CNG and CED tones are optional, their main purpose is to enable human beings to tell that there's a machine at the other end of the line, and most fax systems implement them. However, one of the T.30 options for manual fax machines is to handle

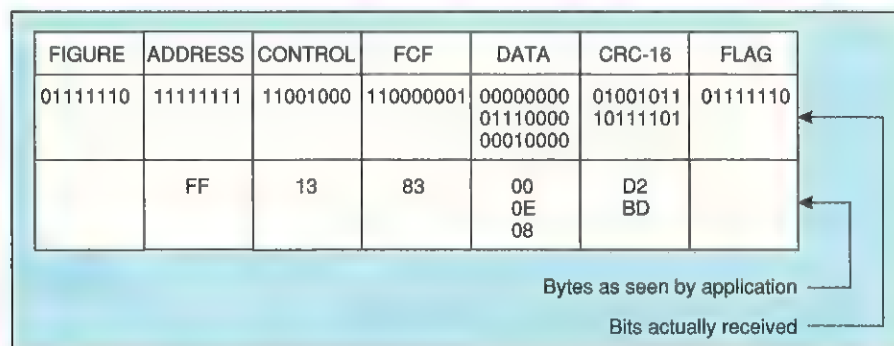


Figure 2 - Sample HDLC Frame



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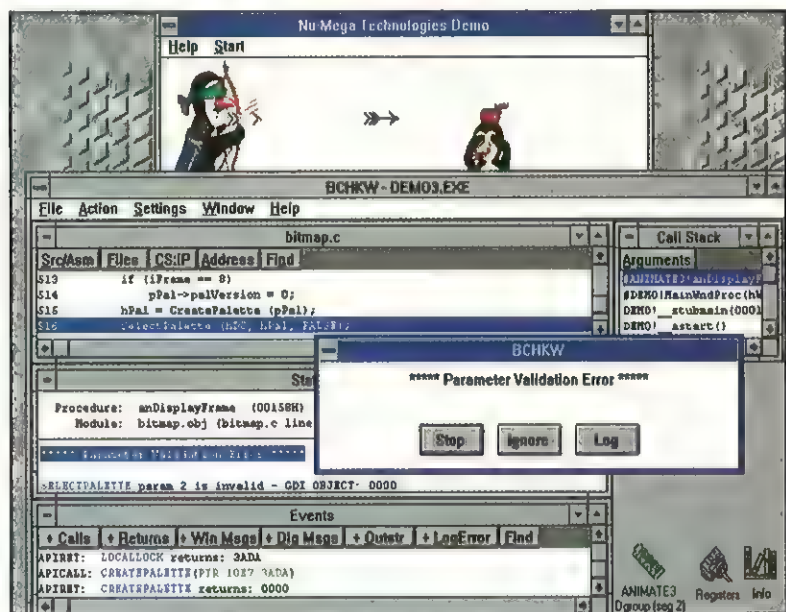
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Phase A entirely through an appropriate verbal exchange. So-called silent faxes take advantage of this option to skip CNG and CED tones completely even though this shouldn't ever be done for automatic fax machines.

Both phase A and the transition to phase B are handled automatically by a Class 1 fax modem as part of the ATD dial or ATA answer procedures.

Phase B

Phase B covers the pre-message negotiations. This consists of an exchange of HDLC frames and begins at 300 bps, using a V21 modulation scheme. As a bare minimum, the answering station kicks off by following its preamble with a DIS frame (Digital Identification Signal) and the calling station responds with either a DCS frame (Digital Command Signal), if it wants to send a fax, or a DTC frame (Digital Transmit Command), if it wants to poll for a fax. These frames outline what the capabilities of the respective machines are, what options they support, and are used to establish the parameters which should be used for the rest of the session.

The basic DCS and DTC frames are optionally preceded by additional items of information, the most commonly implemented of which are the CSI frame (Called Subscriber Identification) from the answering station, and either a TSI frame (Transmitting

Subscriber Identification) from the calling station, if it is sending a fax, or else a CIG frame (CallInG subscriber identification) if it is polling. These frames contain 20 character identity fields with the telephone number of each machine, and are used both for security in polled environments and also more generally to keep fax logs.

There isn't much point in having a large buffer if it doesn't implement sensible flow control thresholds

Subsequent negotiation procedures are controlled by the transmitting station, which initiates commands and waits for responses from the receiving station. The timings here are fairly important. The frames containing the commands or responses are never more than three seconds long, and if

no reply to a command is received within three seconds, then it can be retransmitted up to three times. If there is still no reply, then the transmitting station sends a DCN frame (DisCoNnect) and terminates the session. The whole Phase B negotiation process must be completed inside 35 seconds.

As an example, assume that a fax is being sent, that the first DIS/DCS frames have been exchanged as described above, and that a data rate of 9600 bps has been agreed on. After the transmitter has sent, a DCS it delays for 75 ms (a standard wait before any modulation change) and begins a V.29 9600 bps training sequence of 0s for 1.5 seconds, referred to as the TCF (Training Check Frame). This training sequence effectively enables the modem to work out whether the line is of good enough quality to communicate with the chosen speed. After the TCF, the transmitter returns to the 300 bps data rate to await a response. If the receiver is successfully trained at 9600 bps, it sends a CFR frame (Confirmation to Receive): the Phase B negotiations have been successfully completed.

If the receiver failed to recognise a 9600 bps TCF for 1.5 seconds, it would respond with a 300 bps FTT frame (Failure To Train). In this event, the transmitter would send another DCS frame with a fallback data rate, followed by a training sequence at the lower speed - for instance, FTT at 9600 bps would prompt an attempt at 7200 bps, followed by 4800 bps and then 2400 bps if still unsuccessful. Other possible error responses would generally require re-sending the DCS frame and include CRP (Command RePeat), indicating that the DCS didn't make sense, or another another DTC or DIS, indicating that no proper DCS frame had been received at all. The same action could reasonably be taken if no response at all was received.

Fax Session Parameters

To send or receive V21 HDLC frames via a Class 1 fax modem, simply issue the AT+FRH=3 or AT+FTH=3 command and wait for the CONNECT response. (The only exception to this is when dialling: this implies an AT+FRH=3 as soon as the preamble is seen). The modem will take care of the flag bytes and the frame check sequence bytes (FCS): these are inserted when frames are transmitted; the flags

Where the first bit of the FCF is listed as an x this should be set to 1 if we received the DIS or reset to 0.

DIS	answering capability follows	00000001
CSI	answering station identity follows	00000010
NSF	answering nonstandard facilities	00000100
DTC	polling capability follows	10000001
CIG	polling station identity follows	10000010
NSC	polling nonstandard facilities	10000100
DCS	transmitter parameters follows	x1000001
TSI	transmitter station identity follows	x1000010
NSS	transmitter nonstandard facilities	x1000100
CFR	confirmation to received	x0100001
FTT	failure to train	x0100010
EOM	end of document	x1110001
MP	Send of page	x1110010
EOP	end of transmission	x1110100
MCF	message confirmation	x0110001
RTP	message confirmation with retrain	x0110011
RTN	message not received with retrain	x0110010
DCN	disconnect	x1011111
CRP	command repeat	x1011000

Figure 3 - Main T.30 HDLC Facsimile Control Fields

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are deleted and the FCS is checked when a frame is received. If a frame is in error, the modem reports ERROR, else it reports OK. However, the programmer has to check bit 5 of the control field for each frame received. If it is 0, another frame is due to be received, but if it is 1, then the frame is a final one.

Figure 2 shows a sample HDLC frame from a fax session. Note that all faxes default to using address 11111111. Also, bit 5 of the HDLC control field is set to 1 to indicate that the frame is a final one in the procedure, as described above. The data in the example is a DCS frame sent by a transmitting caller about to fall back to 7200 bps after a failure to train as described above. Other possible frames have different FCF fields - the main ones are shown in Figure 3. Most frames don't contain any data, in which case the FCF field conveys all the information required. One obvious exception are the frames such as the TSI, containing ID information. However, the most important frames with data in are the DIS/DTC/DCS

frames, such as the one shown. All these must contain at least three octets of data.

Figures 4 and 5 detail the meaning of each bit of these three octets. There are extra bit fields possible, which can be flagged by setting the extend bit (24). The latest revision of T.30 now defines 65 bit fields. However, all Group 3 faxes are downwardly compatible and you can always get by with just the 24 bits shown here. Applications software needs to store the parameters from phase B for use in subsequent phases, along with any additional pages of a fax. Before receiving a fax, programmers also need to issue AT+FRM=?, or AT+FTM=?, before transmitting one, in order to determine the capabilities of a modem. (A number of chipsets can send faxes at V.29 9600/7200 bps but can only receive at V.27 4800/2400 bps.)

Phase C

Phase C is the message transmission phase and begins once a TCF/CFR exchange has been successfully completed. It is a unidirectional phase - the transmitter returns to the negotiated high speed data rate, sends another training sequence, and then sends the fax data in encoded T.4 format (assuming that was what had been negotiated). The only slight departure from the T.4 sending method we described last month (using the DLE ETX pair to mark the end of a page and a DLE-DLE pair to send one DLE) is that each line of pels in the fax will usually need padding out with fill bits of 0 before the EOL, in order that a line doesn't drop below the minimum scan time negotiated. (Bear in mind that the T.30 specification assumes that the receiver is a fax machine which is printing out data as it receives it, and that if lines arrive too fast then they don't get printed.)

When using a class 1 fax modem, it is necessary to switch from low HDLC negotiating speed to a higher data speed to send data (or to train). This needs to be prefixed with a 75 ms delay, which can be achieved by issuing the command AT+FTS=8 and waiting for an OK. It will then be safe to enter phase C data via the AT+FTM or AT+FRM commands using the speed negotiated from phase B. The modem responds with CONNECT to these commands.

Phases D & E

Phase D is the post-message procedure phase and begins after the Phase C data has been successfully sent. Remember that, though it ends with an RTC (Return To Control) sequence of six EOLS, this is signified by the DLE ETX sequence for a fax modem. The transmitter and receiver return to 300 bps and the transmitter then sends a post-message frame. There are a number of these, but the two most common are an MPS (MultiPage Signal), indicating that, though one page has ended, the receiver should return to Phase C for the next page, or else an EOP (End Of Procedure) indicating that the fax and session are now complete and that the disconnect phase should begin. The receiver responds with an MCF frame (Message Confirmation) if all is well. Other possible responses are PIP (Procedural Interrupt Positive) indicating that, though the page was received, further transmissions are not possible and RTP (ReTrain Positive) is required. This indicates that the page was received but that phase B should be reentered as a new TCF or DCS. Negative versions of the last two messages are also possible (PIN and RTN) if the page wasn't received. But there isn't a lot that can be done about this; the usual action taken is to disconnect and try again later.

1	0 = Group 3
2	0 = Group 3
3	0 = Group 3
4	0 = Group 3
5	0 = Group 3
6	reserved
7	reserved
8	reserved
9	1 = transmitter T4
10	1 = receiver T4
11,12,13,14	data rate (see Figure 5)
15	1 = fine resolution
16	0 = standard 1-D coding
17,18	0,0 = 1728 pixels wide
19,20	0,0 = A4 length
	0,1 = unlimited length
21,22,23	minimum scan line time
	000 = 20 ms
	100 = 40 ms
	010 = 10 ms
	001 = 5 ms
	110 = 10 ms (5 ms fine)
	011 = 20 ms (10 ms fine)
	101 = 40 ms (20 ms fine)
	111 = 0 ms
24	extend bit

Figure 4 - DIS/DTC/DCS bit definitions

	DIS/DTC capability	DCS rate
0000	V.27ter fallback only	2400 V.27ter
0100	V.27ter only	4800 V.27ter
1000	V.29 only	9600 V.29
1100	V.27ter V.29	7200 V.29
0001		14400 V.17
0101		12000 V.17
1001		9600 V.17
1101	V.27ter V.29 V17	7200 V.17

Figure 5 - Data Rate definitions for bits 11, 12, 13, 14 in

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Phase E is the call release phase. It consists of sending or receiving a DCN (Disconnect) frame followed by dropping the line with an ordinary ATH command.

Peculiarities

Although it is rather tedious using a Class 1 fax modem to implement the T.30 protocol as described above, it isn't terribly difficult. There are, however, a number of general problems common to both Class 1 and Class 2 fax modems, some of which we referred to last month, which derive from the fact that they all convert synchronous to asynchronous data and *vice versa*.

Since Group 3 fax communications, most commonly occur synchronously at 9600 bps, the asynchronous link has to be able to run at least at 12000 bps if it is to be able to keep up with the 120 characters per second that the synchronous link will deliver in T.4 mode. The specifications simply state that the computer-to-modem speed must be at least 25% faster than the maximum expected line connection speed. As 12000 bps is not a usual option for serial ports, there's a *de facto* standard for both Class 1 and Class 2 modems, which requires that the com-

puter serial port be driven at a fixed speed of 19200 bps. This appears to be a universal extension to the specifica-

The easy part in sending or receiving a fax is squirting out or gobbling up the T.4 data: the difficult part is negotiating with the remote fax

tions and is mandatory no matter what speed the fax is being sent or received.

All fax modem service class specifications insist that at least XON/XOFF flow control must be available to stop the modem buffer overflowing when sending a fax. It is assumed, when

receiving, that the computer will be able to take anything that the modem chucks at it, so there is no handshaking or flow control available when receiving a fax.

Implications of Synch

What makes XON/XOFF flow control particularly difficult is that synchronous data must be sent as a continual stream of bits. Unlike asynchronous communication, where there is effectively silence between the stop bit of one character and the start bit of the next, there is no such thing as silence on a synchronous link, as the receiver samples bits at specific intervals as either 0s or 1s. In order to maintain continuous communications, all fax modems have buffers which are needed to handle speed conversion from 19200 as well as to supply a continuous stream of bits to send.

Obviously, a large buffer is useful if you are sending a fax from disk: being able to dump a whole sector into the modem buffer makes the time constraints involved in accessing the disk a little less critical. Given the size of T.4 fax images, storing them in memory is not always practical. However, to avoid the problem of synchronous underrun (having no data to transmit), the size of the buffer is of less importance than the way it works with flow control. There isn't much point in having a large buffer if it doesn't implement sensible flow control thresholds. An example will make this clearer.

The Class 2 command AT+FBUFF? is supposed to return the total buffer size, XOFF threshold, XON threshold, and the number of bytes currently in the buffer. There is no comparable class 1 command, but for both types of modem, buffer sizes as low as 104 bytes with an XON threshold of 16 bytes are not uncommon. If a fax is being sent at 9600 baud, the 16 bytes left in such a buffer will be emptied in only 10 ms. The largest single cause of fax transmission failure using a fax modem may well be the inability of some serial port handlers to respond to an XON from a modem within the period of time that it takes the rest of the buffer to empty. This is particularly problematic if the handler is subject to the demands of a preemptive multi-tasking operating system which *can't* guarantee access to a CPU at least once every 10 ms. The only practical solution to this problem is either to buy a fax modem with a

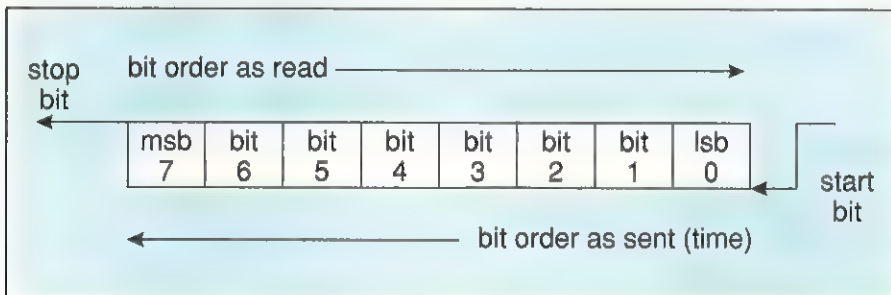


Figure 6 - Sending asynchronous data

```

unsigned char reverse (unsigned char byte)
{
    static unsigned char backbyte, newbit, mask ;
    for (backbyte=0,newbit=0x1,mask=0x80 ; mask ; newbit<<=1,mask>>=1)
        if (byte & mask) backbyte |= newbit ;
    return (backbyte) ;
}

```

Figure 7 -

C function to reverse the order of the bits in an 8-bit byte

```

mov     ah,al
mov     cx,8
reverse:
shl     ah,1      ; shift bit out into carry from left
rcr     al,1      ; shift bit from carry in to the right
loop    reverse

```

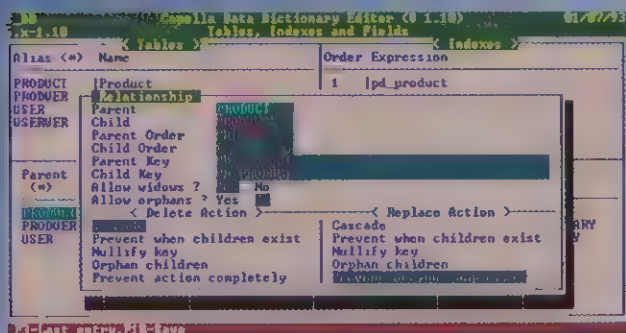
Figure 8 - 80x86 assembler fragment to reverse a byte in al

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S_REPORTCMD	s_ReportNew()	s_ReportModal()	s_Report()
S_MENUCMD	s_MenuNew()	s_MenuModal()	s_Menu()
S_QBECMD	s_QBENew()	s_QBEModal()	s_QBE()
S_ALERTCMD	s_AlertNew()	s_AlertModal()	s_Alert()
S_BOXCMD	s_BoxNew()	n.a.	s_Box()

Capella Software has just announced that two parts of the Capella PDS - dbClass and the Capella DDE - will now also be available as independent products

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large buffer and sensible thresholds, or else to implement interrupt-driven transmission routines which themselves incorporate a large enough buffer to keep the transmission going.

Backwards with Async

A more subtle problem is caused by the way that data is transmitted. Given that fax transmission is bit-oriented rather than byte-oriented, it makes sense for the first bit received by a fax modem from a computer to be the first bit which it sends to the remote machine, and for the first bit received from a remote machine to be the first bit sent back to the computer. But asynchronous data has its own way of working, which is that the least significant bit is always transmitted first, and the most significant bit, last. This is illustrated in Figure 6, where it is apparent that the bits in a byte are actually sent in the reverse of the order in which we naturally would read. We can see the problem this causes for a synchronous link when we attempt to transmit a byte aligned T.4 EOL pattern to a fax modem. The bytes read as follows:

```
00000000 00000001
```

The first byte consists of eight zero bits. Obviously it makes no difference which way round this one goes. However, reference to Figure 6 makes it apparent that the second byte will be transmitted asynchronously with the least significant bit 1 as the first bit sent. So when this bit is sent on first by the fax modem, it won't be sending an EOL at all. The same problem occurs when receiving data. If you refer back to Figure

1, it can be seen that the data bytes received by an application program are actually the reverse of the octets of bits received by the modem.

There is no such thing as silence on a synchronous link, since the receiver samples bits at specific intervals as either 0s or 1s

One solution to this problem is to program T.4 and T.30 data backwards. While for T.4 data this is simply counter-intuitive, for the T.30 HDLC frames it adds an extra level of complexity to any code and can introduce an extra source of bugs. Another solution, which we adopted for Class 2 modems last month, is to use the +FBOR command to tell the modem to reverse the bits for us; however, this isn't available for Class 1 modems.

Though there's a small performance penalty, my preferred method is to

reverse the bytes on sending and on receiving. The extra time needed is the only disadvantage, but this is not critical. It is outweighed by the fact that a program can use a natural representation rather than a reversed bit-order. It is also the most logical thing to do, as it simply reflects the reality of the way things work.

For those who find bit manipulation difficult, Figure 7 presents a simple C function to reverse a byte of data. Figure 8 presents an 80x86 assembler fragment suitable for embedding in C code which does the same thing rather quicker and may well be easier to follow.

There are two exceptions to the need to reverse fax data. One exception is when receiving with a Class 2 fax modems, as they always reverse received T.4 data before passing it on, even when FBOR=0. It seems that this was originally a bug in the Rockwell chipset, which everyone else copied, and consequently it never got fixed.

The other exception is that all fax IDs passed as data in T.30 and Class 1 CSI/CIG/TSI frames is already reversed: and not only is the bit order reversed, but the byte order is also (so 123-4567 is sent as 7654-321). There may be a certain mad logic to this, but what it might be escapes me for the moment. However, it does finish the series on an appropriately messy note. Happy faxing !

EXE

Finding more facts on fax

CCITT Fascicle VII.3 contains the T.30 recommendation. This is one of the CCITT Blue Books which can be found in a few good technical libraries. I obtained my copy from the Science Reference Library in Southampton Buildings, Holborn, London. This establishment has not yet been privatised: admission is still free, though it charges for photocopies. It doesn't yet have the latest T.30 revision, which is published as CCITT White Document COM VIII-164.

There appears to be no UK library in the country with the EIA/TIA-578 Class 1 standard. However, either BSI (0908 221166) or Omnicom (0438 742424) will sell you a copy - possibly bought in from Global Engineering Documents in California (fax 0101 714 2617892) who appears to be the most widely used transatlantic source.

The only public domain account of Class 1 is the one compiled by Supra, which is to be found on its US bulletin board (0101 503 9672444) or from various Internet sites. The only technical support I've had from British modem manufacturers for Class 1 has been from Sonix (0285 641651). Developers seeking to purchase modems with adequate technical backup should always check whether source documents are available.

Andrew Margolis runs a software house and consultancy specialising in communications, emulations, fax, EPOS and utilities for a wide range of systems. He can be contacted at Margolis & Co on 081 8897755 and is always looking for work. While binaries for his fax software are available as shareware (see exe/files on cix), if you don't feel like writing up the source code all by yourself, you can obtain it from him when you register the shareware for £30. Though certain component level I/O routines are in assembler, you get all the C code for encoding, decoding, sending and receiving faxes together with all the relevant data structures. Considering the typing time you'd save this represents a real bargain.

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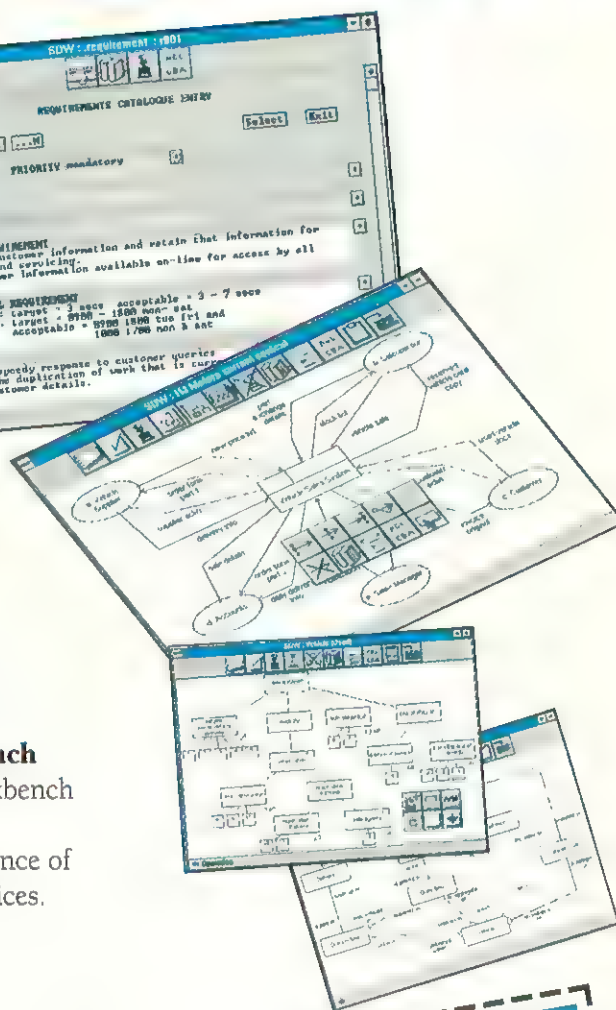
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A066

Annual Hawaii International Conference on Systems Sciences, describing a Markov Modelling technique for prediction. They used it successfully for data compression, and also in a computer implementation of the children's gambling game 'Paper, Scissors, Rock'. In it, the computer attempts to predict the next symbol (P, S or R) output by the human opponent. The rules are as follows:

- Rock beats scissors (by blunting them)
- Scissors beats paper (by cutting it)
- Paper beats rock (by wrapping it)

The best playing strategy is to make one's own plays random and unpredictable, while at the same time trying to predict the opponent's next move. After a learning phase, the program played quite well, consistently beating human opponents, who are very poor at unpredictable behaviour. Patterns of play are inevitable and hard for us to hide.

To test and calibrate their prediction method, Horspool & Cormack then decided to apply it to the output of a good pseudo-random number generator, the UNIX `random()` function - regarded as far superior to the absolutely hopeless `rand()`. Their test program attempted to compress the bit stream generated from `b=random() & 01`; an attempt that should have failed. Imagine their surprise when they succeeded! In fact, on further examination, the alleged random sequence was found to have a short repeating cycle of only 9198 bits, and

was non-random even within that period. Horspool and Cormack had accidentally discovered a new application for their prediction method - as a random bit tester. I should point out in passing that in *my* version of UNIX, `random()` doesn't behave like that - maybe there was a bug in their UNIX implementation.

Testing Bits

Testing a random bit generator for true randomness is traditionally not an easy undertaking. A whole battery of tests

**What comes
next after
110010010-
000111110..?**

are available, and the good generator must pass all of them: the Frequency test, the Serial test, the Poker test, the Run test and the Autocorrelation test to name but a few. (See Chapter 3 of Knuth's *The Art of Computer Programming*, Vol 2 for more details.) Individually, each of these tests is, in mathematical parlance, necessary but *not* sufficient. We can have increasing confidence in a generator that passes more and more of these tests - but there must remain a nagging doubt.

Recently Maurer [2] has developed a 'Universal' test, based on the Horspool and Cormack idea, which is able to detect any one of a very general class

of statistical defects, including all those found by the five tests I have named above. Loosely speaking this test, while not in itself sufficient, is more necessary than most. However, unlike Horspool and Cormack, instead of actually attempting to compress the sequence, this test merely computes a quantity that is proportional to the length of the compressed sequence. The program is given in Figure 1. As presented it can be used to check the randomness of your compiler's `rand()` function - don't be too upset by the verdict. Note that this test requires a lot of output for analysis, so it takes a little while to run. To test your own favourite generator, rewrite the `generator()` function to deliver eight of your own random bits each time it is called.

Measuring randomness

As it stands the output from the program is a simple good/bad indicator. To see how good or how bad, uncomment the `printf()` statement in the `maurer()` routine. Initially the program tries to find an occurrence of each 8-bit value, and stores its position in a table. If a particular value does not occur within the first `Q` values, the generator is labelled as bad. Thereafter the gap between occurrences of each number is noted, and used to build up a figure of merit for the generator. If this figure deviates too much from its expected value, the generator is condemned as bad. The serious user is strongly advised to obtain Maurer's paper, as many variable parameters of this test have been fixed for the purposes of providing a simple demonstration of the method.

```
#include <stdio.h>
#include <stdlib.h>
#include <math.h>

/* Maurer's Universal test */
/* for Random bits */

#define Q      10000 /* > 3000 */
#define K      1000000L /* > 100*Q */
#define MEAN    7.1836656
#define DEVIATION 1.5*sqrt(3.238/(double)K)

int maurer(gen)
int (*gen)();
{ /* Universal Test for Randomness */
  double sum, ftu;
  int i; long n;
  static long tab[256];
  for (i=0; i<256; i++) tab[i]=(-1);
  for (n=0; n<Q; n++) tab[(gen)()] = n;

```

```
/* check each byte occurred */
/* at least once */
for (i=0; i<256; i++) if (tab[i]<0) return
0;
sum=0.0;
for (n=Q; n<Q*K; n++)
{ /* scan byte sequence */
  i=(gen)();
  sum+=log((double)n-tab[i]);
  tab[i]=n;
}
ftu = (sum/(double)K)/log(2.0);
/*****
printf("ftu = %lf DEV= %lf\n", ftu-MEAN,
DEVIATION);
*****/
if (ftu>(MEAN+DEVIATION) ||
ftu<(MEAN-DEVIATION)) return 0;
return 1;
}

```

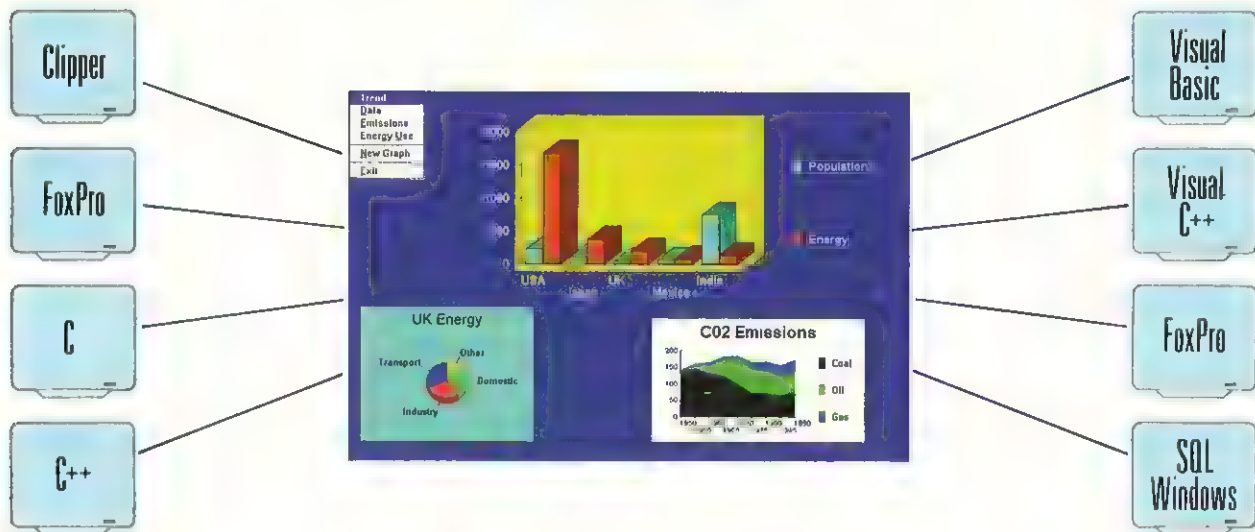
```
int generator()
{
/* Random bit generator. */
/* Pack bits into a byte */
int i, x;
for (x=0, i=0; i<8; i++)
  x |= ((rand() & 1) << i);
return x;
}

main()
{ /* test bit generator for randomness */
  if (maurer(generator))
    printf("This seems to be a GOOD random
bit generator\n");
  else
    printf("This is a BAD random bit gener-
ator\n");
}

```

Figure 1 - The Universal Random Bit tester

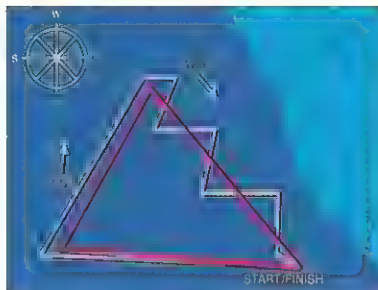
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SECOND**

Blum, Blum, Shub...

Finally how can we implement a good gambling machine - good that is from the Casino's point of view, or a good random bit source suitable for encryption? None of the pseudo-random generators mentioned above would be any use, not even the ANSI 'standard' generator described by Kernighan & Ritchie (Second Edition), because of early cycling. Even a *good* generator such as the one I described in .EXE November 1992, would not be suitable - a computationally well-equipped gambler/wiretapper might guess which generator we were using. And, by observing the random sequence for long enough it would not be too difficult to determine the parameters or 'state' of the generator, and hence reveal all its future behaviour. A more complex generator might suffice. But how can we be positive that its output is truly random?

A suitable generator *does* exist - the Blum, Blum, Shub (BBS) generator. The random bits output from this

generator are taken from the least significant byte of the number generated by the deceptively simple iteration:

$$x = x^2 \bmod n$$

However not so obvious is the fact that n must be the product of two specially constructed large (256-bit at least) prime numbers. Once a suitable n is found, its factors can be discarded. (See the *Modern Cryptology* by Brassard [1] for more details.) The state of this generator is the current full value of x , a large (greater than 512-bit) number. The assumption here is that it is not feasible for anyone to guess the value of x .

Are the bits generated unpredictable? Yes, because it has been proved that any successful method which could be used to predict these bits, could also be used to find the factors of n . It is well known that factoring huge numbers is widely regarded as impossible. So the unpredictability of the bits is anchored firmly on the bedrock of the 'hard' problem of integer factorisation. Thus we can

neatly sidestep the requirement to carry out any tests for randomness on this generator.

On the downside, the BBS generator is awkward to implement in software, and is painfully slow. For example my implementation on a 33MHz 486 PC delivers random bits at the rate of only 4000 bits per second.

.EXE

Michael Scott is Senior Lecturer in the School of Computer Applications, Dublin City University. His main research interest is in Cryptology

[1] BRASSARD, G. *Modern Cryptology. Lecture Notes in Computer Science*, Vol. 325. Springer-Verlag 1988

[2] MAURER, U. A Universal Statistical Test for Random Bit Generators *Journal of Cryptology*, Vol. 5, 1992, pp89-105

[3] SCOTT, M. The Ultimate Random Number Generator, .EXE Magazine, November 1992

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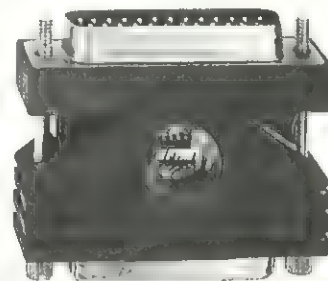
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Heavyweight C++ from Symantec

After the rather disappointing release of Zortech C++ V3.1 Symantec is back with a vengeance with C++ V6. Peter Wright took a look at a late Beta.

The release of Zortech C++ V3.1 did a great deal of damage to Symantec's reputation as a compiler builder. Here was a product which appeared to be, quite literally, a thrown together collection of ageing components. Released in the face of Visual C++ and Borland C++, Zortech stood very little chance of success. Not being one to admit defeat easily, Symantec is back with a completely new, redesigned product. The company's change of tack has paid off greatly; Symantec C++ V6 (SC6) is a definite heavyweight contender in the modern Windows compiler market. Microsoft and Borland would do well to panic a little. This article highlights its new features.

First Glance

Symantec is aiming SC6 direct at Microsoft's home ground. The user interface of the new integrated development and debugging environment (IDDE) bears a marked resemblance to Visual Basic. Microsoft's much praised MFC V2.0 windows class package is included as standard (whether or not this was a wise licensing deal on the part of the big MS remains to be seen). And Blue Sky's rapid prototyping and development tool, Visual Programmer, is also included, bringing Visual Basic-style development to C and C++ programmers.

In addition Symantec has finally released a product which incorporates all the technical know-how which the company has spent the last 18 months acquiring. The full windows resource kit shipped with the compiler bears an uncanny resemblance to the Whitewater resource kit it purchased in July '92. And the three debuggers included in the package have all the functionality

and ease of use you would expect to find from products developed by the Multiscope team (Symantec acquired Multiscope Inc in July '92).

Rather than halting at plain Windows 3.1 development, Symantec has (very) wisely included support for Win32s. (For those not in the know, a Win32s application can run on both Windows NT and Windows 3.1, without recompilation.) DOS programmers have not been forsaken in the sprint to the Windows altar either. A full set of command line utilities is included, as is a very comprehensive set of libraries covering all aspects of DOS development. These include libraries for memory management, TSR creation, swapping, display handling, mouse control and more.

SC6 pulls no punches in the requirements stakes either. Installation of the package requires 80 MB of precious hard disk space, a 386 or greater and at least 6 MB of available memory. The memory figure, though, does actually apply to available Windows memory; the package installed and ran with no problems on my rather sparse 4 MB 486SX.

IDDE

As you can see from Figure 1, the IDDE is a far cry from Zortech's DOS based Workbench (ZWB). Owing a great deal more to Visual C++ and Visual Basic than I think Symantec would care to acknowledge, it represents, in my view, what a windows development environment should feel like.

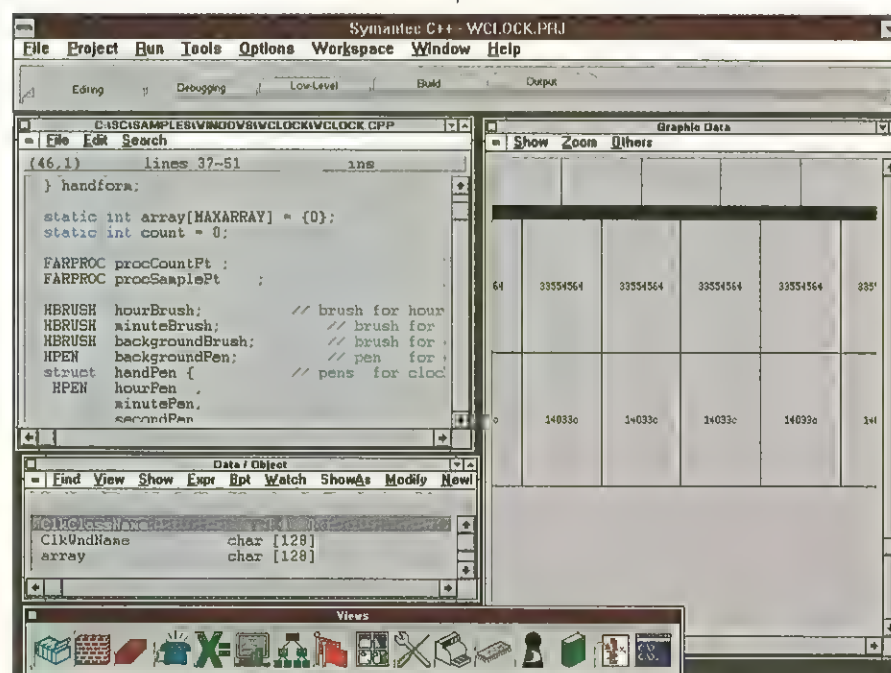


Figure 1 - The new IDDE, compact and bijou, but highly functional

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Struggling Software Sales

One day, trekking through the coffee fields of Java, Don ran into his old college buddy Simon Seagull. "Don, my sales are well below expectations." Simon explained his plight, "My software should sell like yours, Don!" Yet despite critical acclaim Simon's company, SimonSays Software, teetered on a financial tightrope. "What's your secret, Don?"

They spent hours analyzing potential problems. They looked at everything.

The Key to the Problem

Finally, Don leaned back and asked the assumptive question, "What about protection — are you using Sentinel?"

Nervously, Simon sipped his coffee. His hands shaking as his eyes darted the room. "No. I didn't think I needed to."

Don's chair slid out from under him and he crashed to the floor. Amazed in disbelief, Don cried, "You What?!" Grabbing his tattered scrapbook, Don pulled out photos of his travels. "Ever been to Seoul? Prague? Anywhere? Ten bucks will buy you anything, even bootlegged copies of software."

Don's Road to Success

Thumbing through the scrapbook, Don shared his experiences. "Back in the '80s, I was in your shoes — beaten, battered and bruised." Simon listened. "Then, after a heart breaking trip around the world, I called the Software Publishers Association (SPA)."

"I could hardly believe it. They told me developers lose billions of dollars each year. Why? Illegally copied software. In some countries there are nine pirated copies for each legal copy sold."

Simon was disgusted, "It's just not fair."

"That's why I committed myself to solving the piracy problem," explained Don.

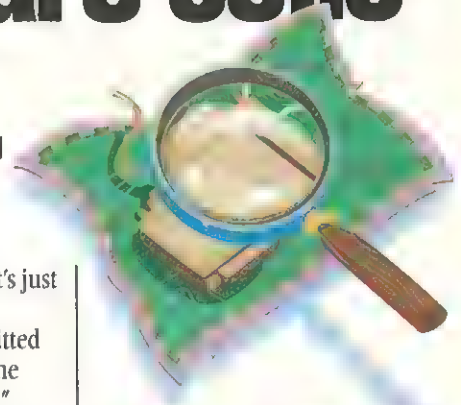
Simon's eyes lit up. "The dongle!" he shouted. Don corrected him, "Not just any dongle — the dongle that paved the road to success for over 10,000 developers worldwide — Sentinel."

Successful Developers Use Sentinel

Don pulled a stack of letters out of his gunny sack. "All of these people tell the same story." Don read about a successful developer from California who swears she wouldn't be in business without Sentinel. Another company says protection costs less than litigation, plus they don't have to spend time and money supporting illegal users.

Others confessed they wouldn't market products internationally without protection.

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The most notable similarity to Microsoft's Visual line of products is in its use of Windows. Rather than taking the more traditional MDI approach (one big screen-sized window with all other data windows in its confines), the IDDE treats each window as an independent entity, doing away with the need for a plain backdrop window. The advantage of this is that you can see the output of other apps from within the IDDE, simply by placing their windows alongside those of any other currently running programs. The disadvantage is that, on all but the most high resolution monitors, the display soon becomes quite cluttered and confusing. The overall effect though is something remarkably similar to Visual Basic.

Once the initial confusion and novelty wears off, you find yourself left with an extremely powerful environment. Sixteen different views of your project are available by dragging the appropriate icon from an icon palette box. These views show such elements of an application as the project file list, memory dump, assembler code, source, function list, data hierarchies and so on. Thanks to a little lateral thinking emanating from Symantec, on the whole, these view windows are aware of the data in other windows. For instance, click on a function name in the function window and drag it to the source window, the view in the source window jumps to the point where that function is defined. Equally, drag a class definition from the data window

into the class window and a tree is displayed showing the class's position within your program's data hierarchy.

One of the most useful features of Visual C++ is its ability to store arrangements of windows in user-defined workspaces. This principle has been adopted and made easier to use in SC6. Underneath the main title bar are displayed tabs, similar in appearance to the section markers in a Filofax. Simply click on the appropriate tab and your preferred window arrangement comes into view. Five are set up as default (with the option for you to define more as you see fit), all displayed with meaningful user-defined names.

Compile and link

As with most modern compilers, the professional edition of SC6 enables compilation from either the IDDE or the DOS command line. The compiler itself is a highly optimised, single-pass C++ compiler utilising technology borrowed from the Zortech package. As with Zortech, compilation is noticeably quick. The speed of the package, in comparison to my former favourite, Visual C++, is noticeably faster, especially when compiling MFC applications.

SC6 incorporates a number of useful features for optimising its compilation speed. As with Visual C++, programmers can elect to pre-compile headers either selectively or globally in

a project. There is also the option of including each header in a project only once. If this is not checked then each time a source is encountered calling for, say, `iostream.h`, the header file is reloaded and recompiled. This reduces free memory usage during compilation and dramatically increases the length of time a program takes to compile.

The linker included in the package is SLR Systems' Optlink V4, a linker which modestly claims to be the fastest in the world. As with the compiler, it is noticeably rapid when compared against BLINK (original Zortech linker) or LINK.

As you would expect from a professional compiler, a wealth of compile options are available, including the inevitable target processor. Instead of the norm, ie implementing x86 to 386/486 then giving up, Symantec has additionally provided direct compilation to Pentium code - good move. This represents the second prudent move in the compiler by Symantec - the first being support for, and inclusion of, the Win32s SDK. These two features alone make SC6 a great deal more useful, in the long term, than either the Borland or Microsoft offerings.

In terms of code handling, the compilers deal quite happily with most of the standards put forward in AT&T's CFront V3.0 standards. However, as with Zortech C++, Symantec have still not implemented exceptions in any acceptable form. Templates are supported though.

Optimisation

One aspect of its compiler which Symantec is extremely proud of is its optimising technology. SC6 supports 11 different kinds of optimisation, each of which can be individually enabled or disabled (either through command line switches or via radio buttons in the IDDE). Using a closely guarded technique known as DFA (Data Flow Analysis), Symantec claims that its optimiser can achieve a speed increase of up to 30% on computation-bound code. The company also wisely acknowledges that, in some cases, this is still not as effective as carefully crafted assembler code: the optimiser looks only at the code, not the algorithm the code is trying to implement.

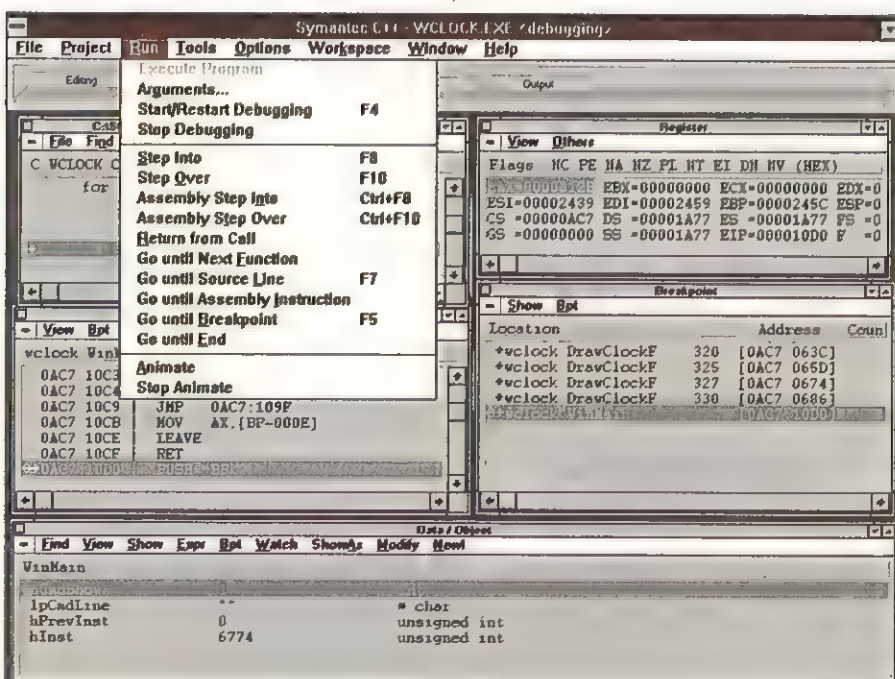


Figure 2 - Debugging in the IDDE

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The optimisations included in the package are comprehensive to say the least. Constant propagation and copy propagation are aimed at replacing variables with constants and *vice versa*, should the need arise. Also included are flags to enable elimination of common sub-expressions, dead assignments, dead code and dead variables. Loops are equally well catered for, with the ability to remove unchanging expressions from loops (loop invariant removal) and speed up array access in loops (loop induction variable replacement).

Since some optimisations may throw out previous ones Symantec have thoughtfully included the ability to loop continuously through the code, optimising until no further changes can be made. Finally, the compiler reference guide includes a 'hints and tips' section detailing further optimisations. It also deals with code that falls over after being optimised (one can imagine this might be fairly common if all options are enabled on a large, ie 25,000+ line, project).

Debuggers

As I have said earlier, the technology for the debuggers, three of them in all, has been borrowed from Symantec's recent corporate acquisition, Multiscope. Few will deny that the Multiscope debuggers were the best available, but integration into the IDDE has curbed them a little. For instance, where in Multiscope it was

easy enough to load in a .EXE for debugging, in-SC6 this is not possible unless you have the project files to hand which created the .EXE in the first place. The same is not true however of the standalone DOS debugger.

The three debuggers comprise two hard-mode debuggers, one for Windows, one for DOS, and one soft-mode debugger. The hard mode debuggers freeze all system activity during a debugging session, useful under Windows where messages may still be flying around in real time thus knocking the program to be debugged out of sync. The soft debugger is a little more traditional. Hosted in Windows, it still allows system activity in the background but being windows-hosted, it is a lot more pleasant to use than the text-based hard debuggers (see Figure 2).

Although these form the three core debuggers of the system, there is also a serial port-based remote debugger and a network aware remote debugger.

In use, all the debuggers appear to function reasonably efficiently. However, they do take a while to master. The Windows-hosted soft debugger is not too bad since its output windows are fully integrated into the IDDE and work in exactly the same way as the other windows in the IDDE. The hard debuggers try to implement a similar arrangement using character-based screens which, quite frankly, doesn't

work too well. Moving windows around is at times an awkward affair with none of the polish of a Windows app. However this is a minor user interface gripe; I could find no major flaws in the debuggers themselves.

Also included are the MED and crash analyser systems previously included with the Multiscope debugger range. These two utilities could prove invaluable in a commercial environment allowing post-mortem debugging on crashed programs. It involves a little extra linking at the compilation stage but the benefits during testing and debugging could prove limitless.

Visual Programmer

Microsoft supplies App and Class wizards with Visual C++, and Borland includes a copy of Protogen with BC++. Symantec, too, ships an application generator with its C++ compiler. This time it's Visual Programmer (VP) from Blue Sky.

VP actually works on two levels. On the first, it is a resource kit, enabling the developer to put together menu structures, dialog boxes and so on. On the second level it allows the developer to link C or C++ code direct to the user interface components in a similar fashion to the Microsoft Class Wizard or Visual Basic. The difference between these is that, in many cases, functionality can be added to a control element without the need to type anything. For instance, the ability to run a third party program is built into the system. If you needed to run such a program in response to the user clicking a button on the screen, then the developer only has to provide the path and file name of the program to run; the rest of the work is done automatically.

A novel feature of the package is VP's testing function. It is possible to design a complete user interface and then run it, without compiling, to see how it works and fits together. If something doesn't look right then it can be changed while the app is running, enabling you to see instantly how the change affects the program.

As with everything else in the package, VP is tightly integrated with other components of SC6. Select compile from the VP menu and SC6 is loaded up and a compilation run. Elect to enter code to link with the user interface and the

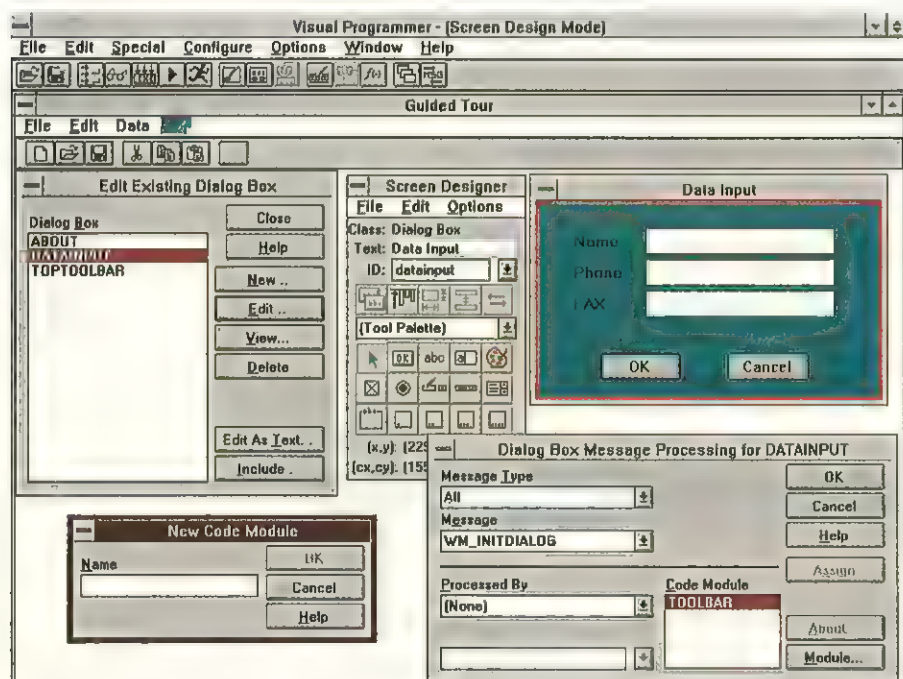
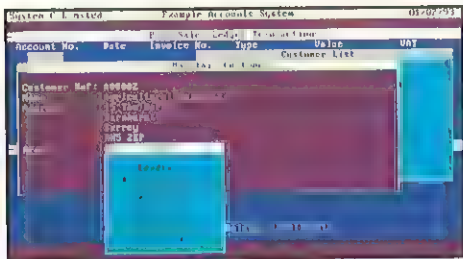
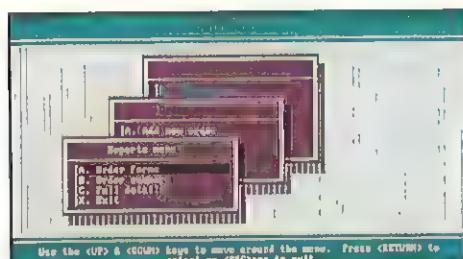


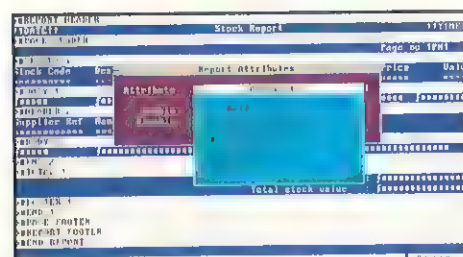
Figure 3 - Blue Wave's Visual Programmer system is included as standard



Sycero supports panels, movable windows, VGA colours, scrolling screens, tick boxes, radio buttons and much more



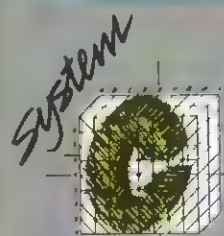
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user can choose to use either the built-in editor, or call up the IDDE. A screenshot of Visual Programmer is given in Figure 3.

Docs & Help

Since the version reviewed here was only a late Beta, the documentation supplied was far from complete. However, that which was supplied was very extensive. Both the *Compiler, Debugger* and *Visual Programmer* guides all made use of readable, easy to follow tutorials which expose the developer to most facets of all these systems in a very short space of time.

Documentation on the compiler itself was of an equally high standard. Not only was the use of both IDDE and DOS compilers covered, but great lengths were also taken to explain how these work, something normally shrouded in some mystery. Full documentation was also supplied covering the ins and outs of SLR's Optlink linker system.

On the whole the documentation was more than adequate and fairly easy going for a package of SC6's complexity. I am reliably informed that there will be even more books included in the final edition, covering both Windows APIs (3.1 and 32s). Hopefully Symantec will have the grace to include some documentation on the DOS libraries too, at the moment these are only covered in any detail in the Help system.

The help files supplied are equally extensive in their coverage of the operational aspects of the package. In addition to the obligatory MS pen, multimedia and Win 3.1 API help files,

**Symantec
C++ V6.0
represents the
culmination of
18 months worth
of corporate
acquisitions:
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extensive online help is also supplied for Win32s and the Symantec DOS libraries. The latter covers all aspects of using these libraries, essential since no paper coverage of them was available for the review. One area that was mysteriously lacking was help for the IDDE. General overviews of the main tool palettes were provided, but that was about all. Hopefully this will be rectified in the final version.

For those explorers among us, a wealth of sample code is also supplied, including fourteen full MFC applications. Included among these is the Scribble application used to teach the use of MFC. The emphasis with the samples definitely lies with MFC though. Only six straight Windows examples are included; and only one DOS program. There are quite a few further examples, however, built into the online help files.

Conclusions

Symantec appreciates that many users will be coming from a competing product. Great attention has been paid in the manuals to converting Borland and Microsoft users to SC6. But the real gems are two small DOS programs called BCC and CL. These 'fake compilers' take a compile string for either Borland or Microsoft C, convert the syntax to that required by SC6, and, if necessary, fire-off the SC compiler. This is a simple idea but it's so effective and useful.

Symantec C++ V6 is what Zortech C++ V3.1 should have been. SC6 has it all: three debuggers, remote debugging, two resource kits (Visual Programmer and a rewrite of the famous Whitewater resource kit), Windows- and DOS-hosted compilers, the IDDE linker and DOS Optlink linker, MFC V2.0...

Symantec C++ deserves pride of place in any serious C/C++ programmer's catalogue. It has all the hallmarks of a package that looks set to stay. It's just my opinion, but I believe Symantec C++ V6.0 is the most powerful C++ development system available on the PC today.

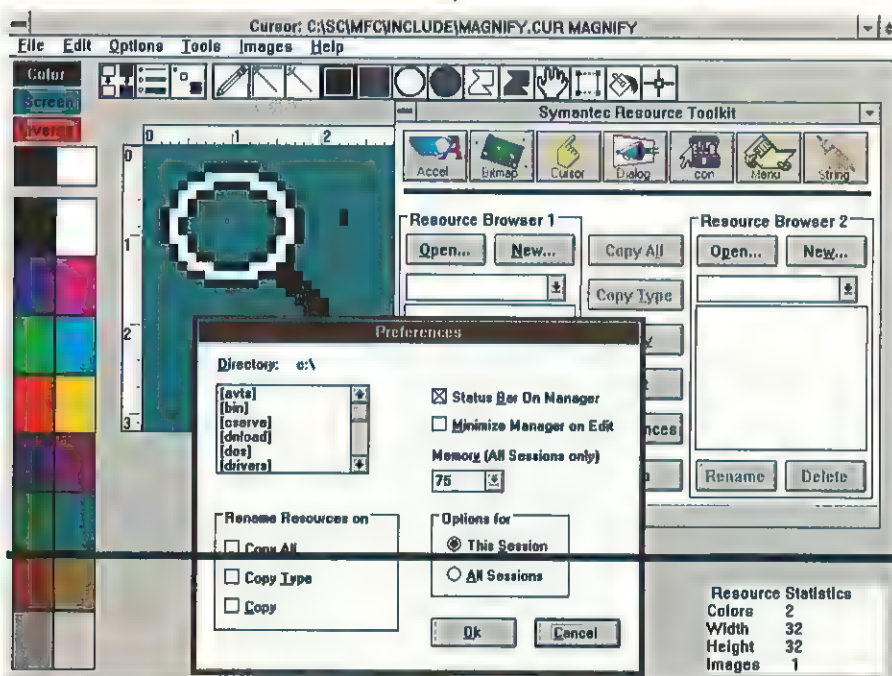


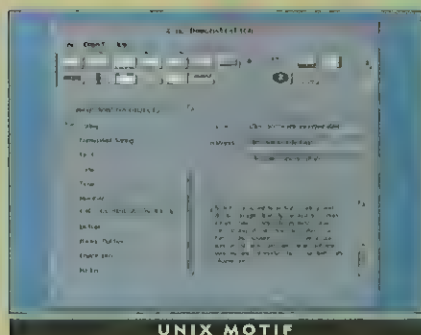
Figure 4 - The Whitewater, sorry, Symantec Resource kit in action

Symantec C++ V6.0 was supplied by Symantec (0628-592222). UK prices were unavailable at the time of writing. The final version should now be shipping.

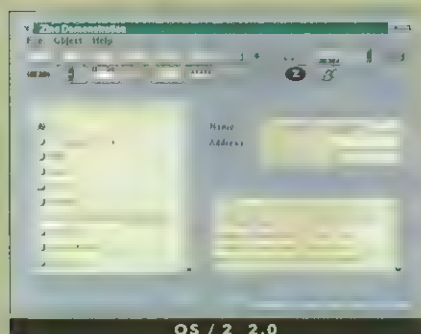
Peter Wright is a professional programmer and software consultant, with slight journalistic tendencies. He can be contacted on CompuServe using ID 100116,357, or via his company, Genesis Software Consultancy, on 0323 507664.



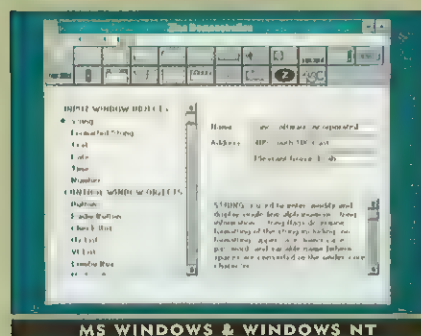
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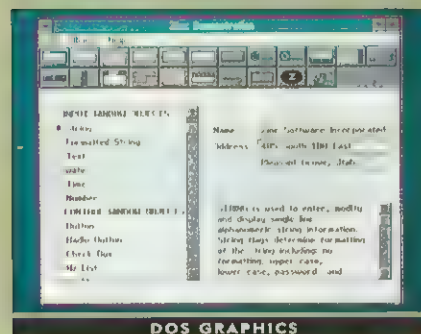
UNIX MOTIF



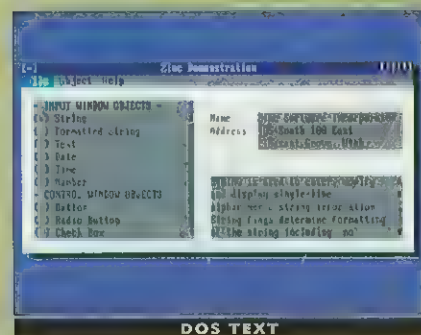
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Computer supplies - The RS232 Breakout Blues

*The catalogue season is with us - indeed when is it not?
Jules has been browsing a few which have been sent to him.*

They say everyone remembers their first time. I remember mine. I was still at school, and was gaining my most formative experiences on an ageing PDP-8, twice my size. Bear in mind that, all those years ago, the idea was bizarre that a computer was something comprehensible - I suppose I thought that computers simply materialised, fully-formed. A gift from the gods. One day, I walked into the machine room, and there it was, just lying on the table for anyone to find. I had discovered my first computer supplies catalogue.

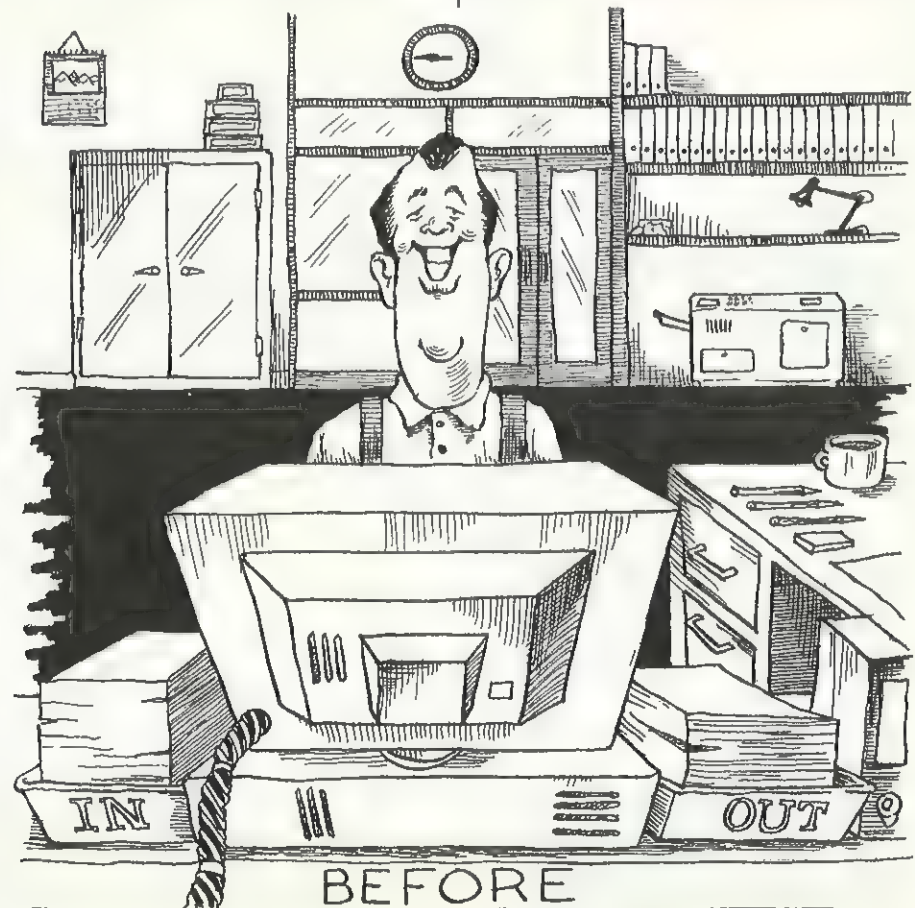
This was something of an eye-opener for me. As I turned the pages, product after product appeared. I had no idea what most of them were, each one illustrated in expensive colour printing and announced with huge, screaming headlines. Was I reading a book about computers, or was I reading *The Sun*?

The same company, and a few others, are sending me their catalogues now - on average, three from each one. (I rang and asked them to stop sending me so many; instead they sent me more!) It still has products ranging from the mundane to the totally useless. It has, for example, 10 pages of *diskettes*. Each line is illustrated in full colour with a photograph comprising a box of disks (in full livery), and a few individual disks carelessly strewn in the foreground, presumably so you will know what a floppy disk is supposed to look like, and perhaps to underline the point that the contents of all these boxes are indistinguishable in any case. Its harder to buy disks from these people

than it is to buy washing powder! But, this gratuitous waste of paper and ink is as nothing when compared to some of the other entries.

This same catalogue sells a cable tidy, which sits on the floor and prevents people from tripping up. It's a reasonably useful product - if your office design is so bad that you need one, I guess you'll know that you need one. But the catalogue company doesn't see

it this way. They have two pictures - before and after. The 'before' picture depicts a man carrying a pile of boxes which incidentally, had they been full, he would never have been allowed to carry anyway. He is tripping over a rat's nest of wires leading from a computer which is being operated by a very shocked-looking secretary. Why she is shocked is beyond me: he must have tripped over those wires a dozen times that day. Neither of them appears



to be capable of learning anything. Nevertheless, the 'after' picture shows the same man, with the same precarious pile of boxes, completely *failing* to trip over the wires. Ah, so that's why we use cable ties! I'm so *very glad* it was explained to me.

Before and after pictures are a very common ploy. They have before-and-afters for anti-glare screens (obvious), antistatic carpets (even more obvious), acoustic printer hoods (slightly less obvious), and even burglar deterrents. What these pictures all show, apart from the product in use, is the comic-book emotions of the protagonists.

However, the programmable, intelligent magic box, headlined 'Solve your RS232 breakout blues', defied even the photographer's ingenuity. Presumably, the before picture would depict a harassed engineer, surrounded by miles of unmarked wire, with a concentrated frown on his face; the after picture would depict a harassed engineer, surrounded by miles of unmarked wire, with a concentrated frown on his face...

The point of this piece is not merely to pour scorn on these idiotic catalogues. You're a programmer, right? I bet you think you're pretty darn smart - far too

smart to fall for this kind of clumsy, amateurish manipulation. I'm equally sure that everyone who receives these catalogues thinks the same thing - that they are unaffected by it. I'm even sure

It's harder to buy disks from these people than it is to buy washing powder!

that most people find this kind of advertising patronising in the extreme. Why, then, do the companies spend so much time, money, and paper on alienating their customers? I think the answer lies in the grimaces on the faces of the models.

Most computer installations comprise lots of boxes which do all sorts of arcane jobs, the mains wires for which represent a significant cabling problem on their own. Most of these installa-

tions are just beyond the limit of comprehensibility of their minders - systems from the smallest to the largest tend to expand until any further tampering upsets them as much as it improves them. When a problem arises, a solution has to be found quickly, easily, and without removing any covers.

This is the market the catalogues hope to address. When you need something in a hurry, when you have valuable records at stake, and you don't trust your machinery, it is easier to find something colourful and glossy. At this time, when you're thinking about your problem, and not concentrating on the pictures at all, their message sinks in, and you identify with the models in the photograph. You see the secretary being polite to callers, the manager smiling for the first time in his life, and you feel better - before you've even picked up the phone. In the next emergency, you will reach for the catalogue again. It doesn't matter how smart you are, if you're sufficiently distracted you will see them only out of the corner of your eye. When you're calm again, you can feel as alienated as you wish.

It doesn't take much planning to avoid having to use these dreadful catalogues, but I can't help wondering why other emergency services don't use the same techniques. Dr Solomon or Norton Utilities could easily be sold this way, possibly generating even more revenue by making sales to people who are barely able to use them. Companies could explain the quality of their helplines using the same technique. The really disturbing possibility, though, is that of services invented specifically to be sold this way. The *late-night sandwich and coffee delivery service*, the *clean up after the spontaneous office party service*, or even the *counselling for the programmer who still can't find that dangling pointer service*. One day everything will be sold this way. What a horrible thought!

EXE

Jules' latest enterprise, the **find the service you need service**, can be contacted on 0707 644185, or on CIX as jules. For a fee, he will arrange catalogues to be sent to you, and will even recommend suitable or interesting pages by telephone.



RDD Roundup

Guy Smith provides an overview of RDDs. What's available at present, how different RDDs work and how to write RDD-independent code.

CA-Clipper V5.01 introduced the concept of the RDD (Replaceable Database Driver) for enhancing the database capabilities built into Clipper. At the time it didn't mean much, as the only full RDD available was DBFNTX. Others were available, but these were transfer RDDs (eg SDF, DELIMITED) which meant they could only import and export between different file formats. Beginning last year and now in full flow, RDDs have come of age. Figure 1 shows a list of RDDs available at the time of writing. And there's more coming. Of course this list doesn't include the vast number of API libraries which have not been made into RDDs.

Usage

There are several ways to use an RDD other than DBFNTX (the default for CA-Clipper applications). The first is to link in a special .OBJ file supplied by the third party vendor which forces DBFNTX out and replaces it with the new RDD. The second is to use the `dbSetDriver()` or `RDDSetDefault()` function in the application to load the RDD explicitly at run-time:

```
* make DBFCDX the default
dbSetDriver('DBFCDX')
```

There is no difference in purpose or syntax between `dbSetDriver()` and `RDDSetDefault()`. The former is present only for compatibility with Clipper V5.0; the latter is only available in V5.2.

Another alternative is to specify the name of the RDD whenever file-based commands or functions are used with the VIA clause:

```
USE MYFILE VIA "DBFCDX"
COPY TO TEMP VIA "DBPX"
```

The last method is the least attractive as it creates dependencies in your code: I would recommend you avoid it since you want to be writing as much reusable code as possible.

Indexes

As you can guess from the list in Figure 1, most RDDs, at present, use good ol' .DBFs as the data file format. However, many popular RDDs replace the indexing mechanism. There is a popular myth that you can run your applications with a new RDD simply by slotting it in, relinking (and sometimes recompiling first). This just isn't true. Later in this article I will present my

evidence. For now, I'll look at some of the properties of RDDs. The most common feature of new RDDs can be summarised in the three C's:

- Compound
- Compact
- Conditional

Compound means that, instead of putting each index order in a separate index file (eg .NTX), several index orders are placed in a single file (eg .CDX).

Compact means that indexes are stored in compact form. This is seamless. So far as the application programmer is concerned all index data is compressed and uncompressed as needed. Surely then this doesn't cause any programming problems you say? Probably it won't. But if you create temporary indexes on a RAM drive it might. If you create a temporary index on a RAM drive you will certainly want to compare the amount of disk space free on the RAM drive with the expected size of the index to see if the RAM drive can, indeed, be used. Figure 2 illustrates how the calculation would be performed using NTX. The problem is that there is virtually no way to know the size of a compound index. Your best guess is:

```
nReccount * nKeyLen
```

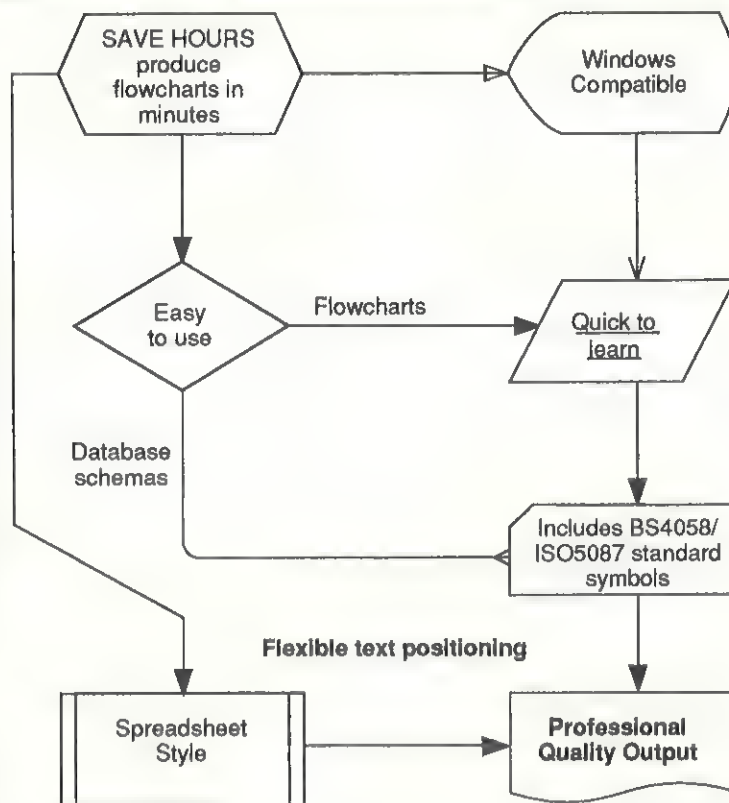
which is a considerable overestimate, particularly in view of the fact that these indexes are compact.

Conditional means that you can create indexes on a FOR condition. Only those records which match the condition will be included in the index. The index maintains the FOR condition even when records are added and key fields are changed. Fortunately this feature brings no problems.

DBFNTX	CA-Clipper 5.01, 5.2	-	The faithful standard
DBFNIX	CA-Clipper 5.01 (US), 5.2	-	dBASE compatible indexes
DBFCDX	CA-Clipper 5.2	-	FoxPro compatible memo/indexes
DBFMDX	CA-Clipper 5.2	-	dBASE IV compatible indexes
DBPX	CA-Clipper 5.2	-	Paradox 3.5 data and indexes
DBFSIX	The SIX Driver	-	FoxPro compatibility
DBFCMX	Comix	-	Proprietary indexes
DBFNSX	Hiper-Six	-	Proprietary indexes
DBFNTXAX	Advantage NTX	-	Client/Server DBFNTX
DBFCDXAX	Advantage CDX	-	Client/Server DBFCDX
FLEXFILE	FlexFile RDD	-	Proprietary memo system
RDDKIT	The RDDKit	-	Collection of 6 RDDs
RASQLB	RaSQL/B	-	Btrieve compatibility
RASQLX	RaSQL/X	-	Netware SQL compatibility
Special cases:			
MachSix	RushMore-like query optimiser for DBFSIX and DBFNSX		
ClipMore	RushMore-like query optimiser for DBFCMX		

Figure 1 - List of RDDs available today

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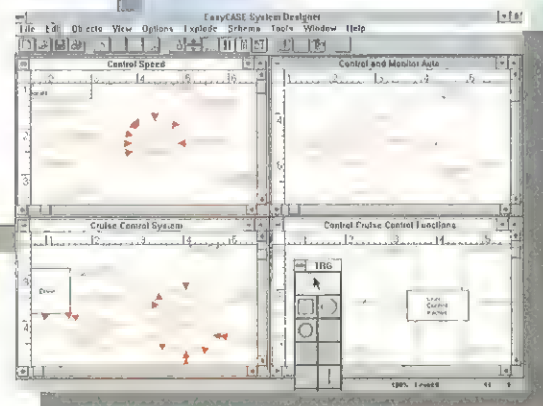
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Pundits often claim that it is easy to use a different RDD by replacing all:

```
if file('MYINDEX.NTX')
```

with:

```
if file('MYINDEX'+indexExt())
```

and relink the application.

This is a short-sighted translation. There's a lot of code out in the real world which works as follows:

```
for n:=1 to nNumberOfIndexes
  erase ('SALES'+str(n,1)+
    indexExt())
next
```

Clearly, if you change from a single order 'bag' with one index per file (eg .NTX) to a multiple order 'bag' which stores several indexes per file (eg .CDX), code like this will not work. This is particularly relevant for all those routines which perform 'self-healing' of indexes (ie when the application starts up, it checks to see whether indexes exist and, if not, it rebuilds them). It is also relevant if you use a data dictionary of any kind.

Tags

Now the introduction of compound index files means a few changes to your code. In single order bags before V5.2, you would change the controlling index using:

```
SET ORDER TO 2 or:
dbSetOrder(2)
```

You can still do this with compound indexes, but your application will not behave consistently. The problem is that index orders (or 'tags') move around inside the index order bag. When you create all the indexes, the first order may well be first in the index bag, the second order second, and so

on, but it won't stay that way for long. Every time you reindex the tag, the order will be put at the end of the list. So SET ORDER TO 2 may get a different order from one run of the application to the next. For this reason most RDDs now allow the setting of a controlling index by a name (a 'tag' name) instead of an order:

```
SET ORDER TO TAG STOCKID
```

This also adds to the readability of the code and eliminates the problem of deleting an index in a list and having to renumber all higher indexes in the source code. However, changing to tags also means that it is a one way trip for CA-Clipper V5.01 programmers: DBFNTX in V5.01 has no concept of tags.

The lack of permanence of the relative position of index orders to each other has a knock-on effect: the behaviour of DBFNTX to issue a SET ORDER TO 1 automatically when indexes are opened has no meaning. As a result, the default order when multiple order bags such as CDX are opened, is 0 (ie natural order). This may require adjustment of existing code to cope with such behaviour.

Due to the necessity for a tag name (instead of an index order number), all RDDs after V5.01 support tag names regardless of whether the index type allows single or multiple order bags. This improves the portability of code across V5.2 applications. However, not all RDDs which support the use of tags have tag permanence. For example, whereas you can use tag names with DBFNDX in V5.2, the tag name itself cannot be stored in the .NDX index. The index can be created with a tag name when using DBFNDX and it will respond to this tag name, but as soon as the index is closed, the tag name is forgotten. On subsequent use of the index the tag name is defaulted to the file name of the index.

Most RDDs which support compound indexes support multiple index types as well. DBFCDX supports both CDX (multiple order bags) and IDX (single order bags). However this creates an ambiguity in the indexExt() function. If two index types are supported, which should a call to indexExt() return? At present it returns the single order bag type (eg NTX, NDX, IDX, PCB). If you are using multiple order bags (which is, after all, one of the reasons for using a different RDD) CA-Clipper cannot help you with writing reusable code which deals with index file names.

Where multiple index types are available, the normal practice is to use the multiple order bags for permanent indexes, and the single order bags for temporary indexes. The reason for this is that a temporary index will be deleted after it is used. Space occupied in multiple order bags is not reused when a tag is deleted, so creating temporary indexes in a multiple order bag creates index 'bloat' (think of this as equivalent to 'memo bloat' for indexes). However, it is not strictly necessary to use the secondary index type for temporary indexes as many, but not all, RDDs allow more than one multiple order bag per data file. So the temporary indexes can go in the second multiple order bag. Unfortunately you have to know which RDDs support multiple, multiple order bags and which don't. Furthermore you can't simply decide to create all temporary indexes as single order bags. For instance, Hiper-Six only supports multiple order bags.

Production Indexes

A production index is an index which is automatically opened when the data file is opened. The index has the same name as the data file so:

```
USE MYFILE VIA "DBFCDX"
```

opens the data file and indexes, if MYFILE.CDX exists. To date, only multiple order bags can be production indexes. This is useful as it increases the amount of reusable code. However multiple order bags make the need for production indexes less important. The following code is reusable regardless of the number of indexes associated with the data file:

```
USE MYFILE INDEX MYFILE1
```

```
function NtxSize(nReccount, nKeyLen, nMode)
* Purpose :- to return the maximum or minimum index size for an NTX file
*
local nMinKeys:=int((1020/(nKeyLen+10))-1)/2)
local nBytes
nMode:=if(valtype(nMode)!='N', nMode, 1)
if nMode=2
  * calculate minimum size
  nBytes:=1024*(2+int(nReccount/(2*nMinKeys)))
else
  * calculate maximum size
  nBytes:=1024*(2+int(nReccount/nMinKeys))
endif
return(nBytes)
```

Figure 2 - Determining the size of an NTX file

NG-2-HLP

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(assuming that MYFILE1 is a multiple order bag).

It is also interesting to note that, whereas all RDDs which support multiple order bags support production indexes, not all are capable of supporting indexes which are not production indexes (eg Comix).

Physical Existence

Some of the problems of the different types of physical existences have already been discussed. However, there is more fun to be had from this subject. I have already mentioned that if you use the `file()` function to test for existence, then the code will need to be modified if you switch to multiple order bags. What I have not mentioned is that, with single order bags, you can use the `file()` function to test for existence any time. But to test for the existence of a tag, you **must** have the order bag open first (most RDDs have a function to return a list of tags open in the current work area). This difference means that there are two levels of checking for physical existence. First, you need to test to see if the bag exists; then you need to open the bag and test for the tag.

The destruction of indexes also causes problems. With a single order bag you issue `fErase(<indexFile>)`. You will normally want to close the index first before erasing it; otherwise CA-Clipper might decide to flush the index buffers to the screen: the user will not be impressed. Conversely, to destroy a tag, the index bag **must** be open first. Consequently, it is difficult to write code which is portable between the two types of indexes.

RDDs exist for both Btrieve and Netware SQL. In Btrieve, index orders are often maintained inside the data file itself; in SQL engines, all tables and all indexes are maintained in a single file. At present RDDs provide no help in writing code which can hide these differences.

Finally there is no `fileExt()` function equivalent to CA-Clipper's `indexExt()` function for indexes. As Paradox and other formats do not use the .DBF file extension, this can lead to further problems.

Scoping/Logical Records

Many third party RDDs (but not the RDDs in V5.2) allow tables to be scoped. They also support the concept of logical records. To set a scope use:

```
SET SCOPETOP TO <top>
SET SCOPEBOTTOM TO <bottom>
```

For example:

```
SET SCOPETOP TO "LONDON"
SET SCOPEBOTTOM TO "NOTTING-
HAM"
```

From this point on the table appears as if only those records which are in the scope are in the table. So `GO TOP` goes to the first record at or after 'LONDON'. This very useful feature cuts out the need to write specialised `TBrowse skipBlocks`.

Logical record numbers are very useful for scroll bars. You often need to be able to determine the current record's position relative to the top of the index order. `RecNo()` does not help here as it returns the physical record number (or indeed record identity). A function, usually called something like `KeyNo()`, returns the logical record number and `KeyGoto()` goes to a logical record number (in the same way that `dbGoto()` goes to a *physical* record number).

Both scoping and logical record numbers are very useful features which present no problems in writing reusable code other than the fact that CA-Clipper's own RDDs do not support such features at present.

Query Optimisers

MachSix (for The Six Driver) and Hiper-Six and ClipMore (for Comix) both provide query optimisation similar to FoxPro's `RushMore`. Query optimisation is achieved by recompiling code with a special header file and relinking with additional libraries. No physical change to the source code is required in terms of syntax (other than the recompiling). A small change may be required to the methodology of multi-user applications. Both query optimisers take a snap shot of index data and perform optimisation based

upon this information. If the index data changes (ie records are added by other users or index fields updated) then the `SET FILTER`, unlike normal CA-Clipper `SET FILTER`, will not reflect the changes. For this purpose both products include a way of refreshing the filter. Along with their optimisation ability, these RDDs also provide a host of other less useful (irrelevant?) commands such as `AVERAGE`, `COUNT`, `LIST` and `SUM`.

Query optimisation occurs on `SET FILTER` and `LOCATE`. The effects of either `MachSix` or `ClipMore` are considerable. The only caveats in the usage of either product are that you should check the documentation to see exactly which expressions are optimisable and which are not. Clearly a basic requirement is that the query expression contains at least one field for which there is an index.

The result of all of this is that the `SET FILTER` command is now a credible part of the language. The contempt and scorn which the command has attracted for years is no longer appropriate when it is used with a query optimiser.

One point to note when using either `MachSix` or `ClipMore` is that both are supersets of existing RDDs (`DBFSIX/DBFNSX` and `DBFCMX` respectively). This means that the RDD name does not change. Lines like this:

```
USE STOCK VIA "DBFSIX"
```

do not change when `MachSix` is used in addition to The Six Driver. This means that it is not possible to make a distinction between a table which uses just an RDD and a table which uses an RDD *and* a query optimiser. This is relevant for code which stores the RDD name in a data file (for data driven applications) and for code which needs to be able to determine the behaviour of a table at run-time based upon the RDD being used.

Additive RDDs

Several RDDs fall into a unique category - that of the 'additive' RDD. These RDDs are not 'host' RDDs. Instead they add functionality to an existing RDD. A few examples are given in Figure 3. Such RDDs require a 'host' RDD to provide the default behaviour. They add or modify specific behaviours. The existing RDD

FlexFile RDD	-	Replacement Memo System
The RDDKit	-	Collection of 6 additive RDDs
Hiper-Six	-	High Performance Index Replacement

Figure 3 - Examples of additive RDDs

Agility

The Instant Form Manager for VBA/VB

Ernie's Order Browser

Exit

Select a customer:

Cust #	Customer name
10000	Willard Scott
10001	John Smiley
10002	Thomas Wilson
10003	Mark Branson
10004	Thomas Merton

Willard Scott
4323 Williamson Drive
Apartment E
Sonoma CA 94023
Phone: (018) 282-7837

Order info

Qty	Item #	Description	Price	Item total
1	100-083	Odd lot forks	7.95	7.95
24	500-081	Toothpicks	99	23.76

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Discount: 0.00
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system in CA-Clipper V5.01 and V5.2 does not provide a standard for specifying an RDD inheritance chain, so each product differs in the mechanism it employs to add functionality.

The inheritance problem is simplest for Hiper-Six. Hiper-Six has a hard-coded algorithm for deciding which host RDD to use. At run-time it looks to see if DBFSIX (The Six Driver) is loaded and, if it is, uses it as the host RDD. If not, it looks for DBFCDX (CA-Clipper V5.2). If DBFCDX is not loaded it looks for good ol' DBFNTX. This decision as to which RDD Hiper-Six inherits from cannot be changed. In the program you would write:

```
USE STOCK VIA "DBFNSX"
```

The FlexFile RDD is a little more flexible. Note that this discussion is concerned with the FlexFile RDD and **not** the FlexFile API. With FlexFile you can specify which RDD FlexFile should inherit from using FlexFile's `V_SuperRDD()` function:

```
V_SuperRDD("DBFNTX")
USE STOCK VIA "FLEXFILE"
```

The most flexible of the additive RDDs is The RDDKit. This is out of necessity as The RDDKit is a collection of six additive RDDs of which any or all can be used simultaneously. The six RDDs are shown in Figure 4.

So in the program you would write:

```
setInherit({"DBFNTX"})
USE STOCK VIA "CRYPT"
```

As has been mentioned above, CA-Clipper has no standard for inheritance, so The RDDKit's own `setInherit()` function is used. As usual, when a standard has not been defined it is difficult for third party vendors to maintain compatibility (eg FlexFile's `V_SuperRDD()` and The RDDKit's `setInherit()`).

However, as many RDDs can be used in the inheritance chain you could also write:

```
setInherit({"MEMO", "CRYPT", ;
            "DBFNTX"})
USE STOCK VIA "BINARY"
```

where BINARY inherits from MEMO which inherits from CRYPT which inherits from DBFNTX.

Memo Fields

dBase's DBT memo fields are notoriously inefficient in all manner of ways. CA-Clipper's file compatible DBT memo fields are smarter, but still suffer from similar problems: the foremost being the dreaded memo bloat. For this reason different memo systems have been devised.

DBFSIX and DBFCDX both use Fox-Pro's more efficient FPT memo files. DBFSIX also has the ability to specify a different block size for the memo file which can further reduce memo bloat. FlexFile allows a host RDD's memo system to be replaced with Ganahl Software's proprietary DBV memo files. And, although dBxStore, is an API library and not an RDD, it uses DBX memo files.

Again the problem of physical existence rears its ugly head. CA-Clipper has no `memoExt()` function equivalent to its `indexExt()` function for indexes. DBFSIX has an `sx_MemoExt()` function but this is only appro-

priate if you use DBFSIX. As a result, any code which tests for the existence of memo files, copies memo files or erases memo files must have the memo file extension hard-coded.

Weakly Typed Fields

Since the dawn of dBASE II, all fields in DBF files have been strongly typed. That is, a field could be guaranteed to have the same data type from one record to the next. With DBFSIX and FlexFile (and dBxStore if you count API libraries) this simple rule changed. Memo fields can have variable data types. So the code extract in Figure 5 is permissible.

Now it is very useful to be able to record 'NIL' instead of 'empty' (there is an important difference) and, depending on your attitude to normalisation, it may be useful to store many record values as an array instead of many records. However, this feature is only useful if your code has been written to be aware of it. Consider how much existing code has been written

Guidelines for RDD Independence

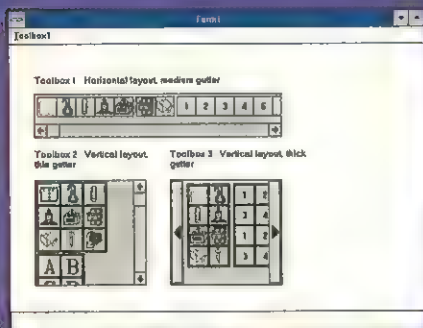
- Any code which is dependent upon the physical existence of tables should be wrapped in function calls so that it can easily be modified.
- Always use tag names instead of index order numbers to refer to index orders. Tag names are essential if the underlying RDD supports multiple order index bags as the relative orders inside the bag can change frequently so `order 3` will not always refer to the same index order.
- Use tag names which would be the same name as the index order bag name would have been if you had used single order index bags. So the first index order of the stock table could be given a tag name 'STOCK1' and the second order 'STOCK2'. This will enable you to switch to an RDD which doesn't have tag persistence (eg CA-Clipper V5.2 DBFNDX).
- Always specify a table default index order using a tag name. When multiple order bags are opened an index is not automatically set as it is for single order bags like DBFNTX (ie `SET ORDER TO 1`) so setting a default index order will assure easy transition between multiple order bags and single order bags.
- Index keys should be based upon fields only as not all RDDs support indexes built upon expressions (e.g. Paradox primary key indexes).
- Place primary key fields together and in order at the beginning of the field list as Paradox primary key indexes can only be based upon contiguous fields at the beginning of the field list.
- Use table lock methods as if multiple record locking is supported. That is, always pass the record identity to be locked. When you need to lock multiple child records use a manifest constant to determine whether to use multiple record locks:

```
if MULTIRECLOCKS
    myLockRecordsInRange()
else
    fLock()
endif
```

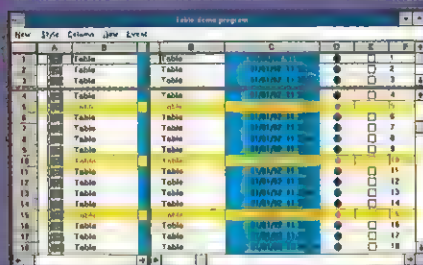
In this way you will be able to immediately reap the benefits of multiple record locking if you switch to a suitable RDD but your code will still work with single record lock RDDs.

- Never use the `dbRecall()` function as not all data sources can physically recall deleted records.
- `RecNo()` does not return a numeric value for all data sources as not all data sources have a concept of a record number. As a result, code which accepts record number parameters should simply compare the parameter against NIL instead of testing the data type using `VALTYPE()`.

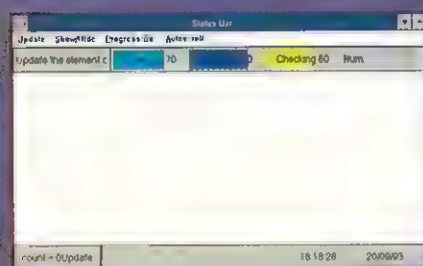
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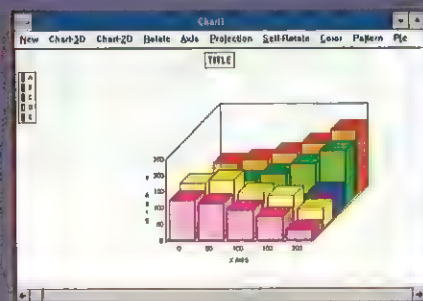
The Ribbon control is a horizontal bar that contains a range of controls, text strings and items (buttons).



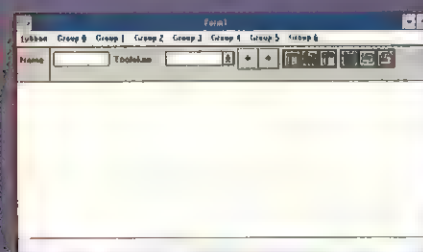
The table can be a regular table (e.g. using data from a database) or a table that maintains a cache of a range of current data and fetches data from the application only when needed.



The status bar can have a maximum of 20 elements including progress meters, text and Separators.



The chart can be either 2D or 3D. It has a title, legend, labels, grid lines, axis. The grid can be configured to suit the database front-end that maintains a cache of a range of current data and fetches data from the application only when needed.



The Ribbon control is a horizontal bar that contains a range of controls, text strings and items (buttons).

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which is not expecting field data types to change from one record to the next.

Sharing Code

There is a basic assumption made by third party vendors which is unfounded in some circumstances. The assumption is this: 'It is acceptable to achieve reuse of code by recompiling with different header files.'

The recompilation using different header files allows commands like:

```
SET SCOPETOP TO
SET SCOPEBOTTOM TO
SET FILTER TO
```

to be mapped onto different function calls (eg `cmxSetScope()` and `cmSetFilter()` instead of `sx_setScope()` and `m6_setFilter()`).

First, this assumption only holds if you always use commands and not functions. This may or may not be true. If you, like me, were enjoying the transition to a wholly function-based language and had ditched commands in

favour of a more C-like style then this assumption is false.

However, there is a bigger barrier to the reuse of source code. That is when the source code is contained in a departmental library shared either by many programmers and/or shared by many applications. In this circumstance you cannot recompile the library. This is partly because you may not have access to the source code, but more likely because, if you recompile the library, you either recompile it for everyone else (and every application) or you create a separate version of the library. Multiple copies of a departmental library soon leads to disaster.

It is quite likely that one programmer may write an application based upon

DBFNTX whereas another, in the same department, may write an application based upon Comix or Paradox. Indeed, a Clipper developer may want to mix and match between different RDDs in the same application. The only solution to this problem is to write database and table class wrappers around the functions.

Often the setting of an RDD standard (eg all application will use DBFSIX) seems to imply that it is safe to build a library on a single RDD. This trap is highlighted by the maxim: 'the only constant is change'. Put simply this means that as change is inevitable in the software world there will be a new RDD out soon (say 'The Acme Seven Driver') which will have to be better than the RDD you currently use. So if

BINARY	-	Long integer and double precision numerics
CRYPT	-	Data encryption
JOURNAL	-	Log all changes to data files
MEMO	-	Use dBaseStore or FlexFile for memo fields
TRIGGER	-	Execute UDF when data file is changed
CATALOG	-	Lookup data file PATH and RDD name in CATALOG

Figure 4 - RDDs supplied in the RDDKit

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you change the standard to the new RDD all of the old applications based on the old RDD are unsupported.

Much CA-Clipper DML (Data Manipulation Language) is genuinely polymorphic. Commands and functions like SKIP, FOUND() and EOF() are reusable no matter what the RDD or the circumstances. In theory, it should be possible to apply such commands independent of the actual data source. Additions made by third party RDDs (eg SET SCOPE TO) are often reusable if you have the luxury of being able to recompile with different header files. Some differences simply cannot be mapped (eg erasing an NTX file requires the NTX to be closed but erasing a tag requires

the index to be open). Other differences require some forethought in the planning stage. I have provided some tips to code reuse in the box 'Guidelines for RDD independence'.

Conclusion

The age of the RDD is definitely here. A lot of code is reusable from one RDD to the next, but the transition from one RDD to the next is far from seamless. Of the RDDs mentioned only The Advantage xBase Server DBFNTXAX RDD requires no change to your source. Some differences arise from the different types of physical existence; some from differences in syntax (eg `setScope()` and `cmxSetScope()`) and some arise

from conceptual differences (eg multiple order bags instead of single order bags). The only way to achieve closer to 100% RDD independence is through encapsulating all data access using table classes.

An interesting final point of note is that the forthcoming CA-Visual Objects For Clipper (aka Aspen) will support both RDDs and table classes. However, RDDs will only be available for record-oriented engines (eg dBASE, Btrieve, Paradox) whereas table classes will be available for both record- and set-oriented engines (Oracle, SQLBase, SQL Server).

EXE

Guy Smith is tired of the drastic reusability of OO code and the sub-second link times of modern linkers and longs for the days of SELECT PRIMARY and SELECT SECONDARY and the five minute link times of Plink86.. NOT!

He can be contacted on 0602 865943 or 100014.1724 on CompuServe or smithg on CIX.

```
* assume TEL_NO is a memo field
GO TOP
REPLACE TEL_NO WITH "081 994 6477"
SKIP
REPLACE TEL_NO WITH NIL
SKIP
REPLACE TEL_NO WITH ("081 994 6477", "081 994 4842", "0753 577733")
GO TOP
? valType(TEL_NO) // "C"
SKIP
? valType(TEL_NO) // "NIL"
SKIP
? valType(TEL_NO) // "A"
```

Figure 5 - Variable data types in memo fields

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Save My Screen!

Far from being some kind of Windows black magic, screen savers are simply plain vanilla executables. Bruce Forman reveals how to write one.

Screen savers are often thought of as one of those amusing 'cubby-holes' that users new to Windows explore, along with wallpaper and bitmaps. However, apart from their ability to provide 'factor 20' protection against 'screen-burn' they have a more powerful role to fulfil in the area of PC security.

For a standalone PC, the protection provided is restricted to preventing the casual passer-by from meddling with whatever is running at that time. Unless you have a machine with a built-in BIOS password, the determined hacker will merely reboot to gain access to data on your hard disk. Where network machines are concerned, a password protected screen saver can

provide a high level of protection if you need to leave your PC for any time. An unattended machine which is logged into a network can be a serious security problem: but you don't always want to logout every time you leave your desk to grab a cup of caffeine.

Securing your PC

As you are no doubt aware, the screen savers shipped with Windows can be accessed via the DESKTOP utility in Control Panel. You are able to associate a password with the screen saver you have chosen. At the same time you can also change the period of keyboard or mouse inactivity after which time, Windows causes the screen saver

to run. The only problem with this method of running the screen saver is that, if you set a reasonable time period of say 5 minutes to prevent the screen saver cutting in too often, then this will still present a security problem for that period of time until the screen saver is run.

I wanted to be able to protect my PC by clicking on an icon to run the screen saver immediately. It turns out that this can be achieved quite easily since Windows screen savers are all, in fact, executable files in their own right. If you look in your Windows directory you should find several files with the .SCR extension. These are the screen saver files; to execute them directly you should rename them to .EXE files.

```

Declare Function ShowCursor%
Lib "User" (ByVal bShow%)

Declare Function GetPrivateProfileString% _
Lib "Kernel" (ByVal lpApplicationName$, _
ByVal lpKeyName$, _
ByVal lpDefault$, _
ByVal lpReturnedString$, _
ByVal nSize%, _
ByVal lpFileName$)

Declare Function WritePrivateProfileString% _
Lib "Kernel" (ByVal lpApplicationName$, _
ByVal lpKeyName$, _
ByVal lpString$, _
ByVal lpFileName$)

Global gbOldPasswd$
Global gbNewPasswd$
Global gbDrawBoxSpeed%

Sub Encrypt (uncoded$, coded$, keystring$)
newkeystring$ = ""
For i = Len(keystring$) To 1 Step -1
newkeystring$ = newkeystring$ + _
Mid$(keystring$, i, 1)
Next
length = Len(uncoded$)
coded$ = ""
For i = 1 To length
letter = i - Len(keystring$) * _
Int(i / Len(keystring$) - .1)
newascval = Asc(Mid$(newkeystring$, _
letter, 1)) + _
Asc(Mid$(uncoded$, i, 1))
coded$ = coded$ + Chr$(newascval)
Next
End Sub

Sub Main ()
'Prevent multiple instances of
' program running
If App.PrevInstance = True Then
Exit Sub
End If
Randomize

'INI file is in application's directory
lpFilename$ = App.Path
If Right$(lpFilename$, 1) <> "\" Then
lpFilename$ = lpFilename$ + "\"
End If
lpFilename$ = lpFilename$ + "BOXES.INI"
' Create INI file if one does not exist
If Len(Dir$(lpFilename$)) = 0 Then
Open lpFilename$ For Output As #1
Print #1, "[Boxes Screen Saver]"
Print #1, "Password = "
Print #1, "DrawBoxSpeed = "
Close #1
End If

'Setup parameters for reading password
' from INI file
lpApplicationName$ = "Boxes Screen Saver"
lpKeyName$ = "Password"
lpDefault$ = ""
lpReturnedString$ = Space$(81)
nSize = 81

'Read password and unencrypt
n% = GetPrivateProfileString% _
lpApplicationName$, _
lpKeyName$, _
lpDefault$, _
lpReturnedString$, _
nSize, _
lpFilename$

lpReturnedString$ = _
Left$(lpReturnedString$, _
InStr(lpReturnedString$, _
Chr$(0)) - 1)
UnEncrypt lpReturnedString$, uncoded$, _
"enigma"
gbOldPasswd$ = uncoded$

'Setup parameters for reading
'DrawBoxSpeed from INI file
lpKeyName$ = "DrawBoxSpeed"
lpDefault$ = ""
lpReturnedString$ = Space$(81)
nSize = 81

'Read DrawBoxSpeed from INI file
n% = GetPrivateProfileString% _
lpApplicationName$, _
lpKeyName$, _
lpDefault$, _
lpReturnedString$, _
nSize, _
lpFilename$

lpReturnedString$ = _
Left$(lpReturnedString$, _
InStr(lpReturnedString$, _
Chr$(0)) - 1)
gbDrawBoxSpeed% = Val(lpReturnedString$)

'Show Setup Window or Screen Saver
' depending on command line parameter
Select Case Command$
Case "/c", "/C"
'Show mouse pointer
X% = ShowCursor(True)
Set lp.Snc%
'Hide mouse pointer
X% = ShowCursor(False)
Case "/s", "/S"
ScreenSaver.Show
End Select
End Sub

Sub UnEncrypt (coded$, uncoded$, keystring$)
newkeystring$ = ""
For i = Len(keystring$) To 1 Step -1
newkeystring$ = newkeystring$ + _
Mid$(keystring$, i, 1)
Next
length = Len(coded$)
uncoded$ = ""
For i = 1 To length
letter = i - Len(keystring$) * _
Int(i / Len(keystring$) - .1)
newascval = Asc(Mid$(coded$, i, 1)) - _
Asc(Mid$(newkeystring$, _
letter, 1))
uncoded$ = uncoded$ + Chr$(newascval)
Next
End Sub

```

Figure 1 - Screen Saver main module

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If you now create a program item with the new executable filename, you will end up with an icon which, when run, will start the screen saver. You should note, however, that there are two command line parameters associated with the new executable. The /S parameter is necessary to start the screen saver.

The /C option will give access to the screen saver's setup window.

The ingredients

Creating our own screen saver involves following a few simple procedure: from thereon we are confined

only by the limits of our imagination. Windows screen savers usually consist of four main elements:-

- The graphical display which constitutes the screen saver itself.
- A setup window for altering the operating parameters of the screen saver.
- A password changing window and routines.
- A password prompt window.

When a typical Windows screen saver, such as Starfield Simulation, is activated, it will run until either a key is pressed on the keyboard, or the mouse is moved. Assuming that a password is set, then the user will be prompted for the password. And if the correct one is entered, the user will be returned to his Windows desktop. If an incorrect password is entered then the screen saver will resume until there is further keyboard/mouse activity.

The setup window allows the user to set operating parameters of the screen saver and a password if required. In the case of Starfield Simulation, the operating parameters which can be altered are the speed of movement through the stars and the density of the starfield.

A Program Example

The example that I have created contains only a very simple screen saver, written for Visual Basic for Windows (VBW), which draws rectangles of random size, colour and position on the screen. All the forms and procedures discussed are available on diskette. See end of article for details. Some of the procedures involved, such as password input and reading/writing information strings from .INI files, have wider uses. So, even if you are not interested in creating screen savers, then I hope you may find these useful.

My screen saver is called Boxes. It uses four forms - one for each of the elements described above - and a module of common procedures.

General Module

The code in Figure 1 contains the declarations for three Windows API calls which are used in BOXES and three procedures. The subroutine Main() is set as the Startup form (by selecting

```
Sub chkPassword_Click ()
    If chkPassword.Value Then
        cmdSetPassword.Enabled = True
    Else
        cmdSetPassword.Enabled = False
    End If
End Sub

Sub cmdCancel_Click ()
    Unload Setup
End Sub

Sub cmdOK_Click ()
    If chkPassword.Value = 1 Then
        If Len(qbNewPasswd$) Then
            Encrypt qbNewPasswd$, coded$, "enigma"
            lpReturnedString$ = coded$
        Else
            Encrypt qbOldPasswd$, coded$, "enigma"
            lpReturnedString$ = coded$
        End If
    Else
        lpReturnedString$ = ""
    End If

    qbDrawBoxSpeed% = . .
    Val(txtDrawBoxSpeed.Text)
    If qbDrawBoxSpeed% < 1 Then _
        qbDrawBoxSpeed% = 1
    If qbDrawBoxSpeed% > 10 Then _
        qbDrawBoxSpeed% = 10

    lpFilename$ = App.Path
    If Right$(lpFilename$, 1) <> "\" Then _
        lpFilename$ = lpFilename$ + "\"
    lpFilename$ = lpFilename$ + "BOXES.INI"
    lpApplicationName$ = "Boxes Screen Saver"
    lpKeyName$ = "Password"
    Result% = _
        WritePrivateProfileString _
        (
            lpApplicationName$, _
            lpKeyName$, _
            lpReturnedString$, _
            lpFilename$
        )
    lpKeyName$ = "DrawBoxSpeed"
    lpReturnedString$ = _
        LTrim$(Str$(qbDrawBoxSpeed%))
    Result% = _
        WritePrivateProfileString _
        (
            lpApplicationName$, _
            lpKeyName$, _
            lpReturnedString$, _
            lpFilename$
        )
End Sub

lpReturnedString$, _
lpFilename$ _
)
Unload Setup
End Sub

Sub cmdSetPassword_Click ()
    SetPassword.Show
End Sub

Sub Form_Load ()
    Setup.Left = _
        (Screen.Width - Setup.Width) / 2
    Setup.Top = _
        (Screen.Height - Setup.Height) / 2
    If Len(qbOldPasswd$) Then
        chkPassword.Value = 1
        cmdSetPassword.Enabled = True
    End If
    txtDrawBoxSpeed.Text = _
        LTrim$(Str$(qbDrawBoxSpeed%))
End Sub

Sub spnDrawBoxSpeed_SpinDown ()
    qbDrawBoxSpeed% = qbDrawBoxSpeed% - 1
    If qbDrawBoxSpeed% < 1 Then _
        qbDrawBoxSpeed% = 1
    txtDrawBoxSpeed.Text = _
        LTrim$(Str$(qbDrawBoxSpeed%))
End Sub

Sub spnDrawBoxSpeed_SpinUp ()
    qbDrawBoxSpeed% = qbDrawBoxSpeed% + 1
    If qbDrawBoxSpeed% > 10 Then _
        qbDrawBoxSpeed% = 10
    txtDrawBoxSpeed.Text = _
        LTrim$(Str$(qbDrawBoxSpeed%))
End Sub

Sub txtDrawBoxSpeed_KeyPress _
    (
        KeyAscii As Integer _
    )
    If KeyAscii = 13 Then
        qbDrawBoxSpeed% = _
            Val(txtDrawBoxSpeed.Text)
        If qbDrawBoxSpeed% < 1 Then _
            qbDrawBoxSpeed% = 1
        If qbDrawBoxSpeed% > 10 Then _
            qbDrawBoxSpeed% = 10
        txtDrawBoxSpeed.Text = _
            LTrim$(Str$(qbDrawBoxSpeed%))
    End If
End Sub
```

Figure 2 - Setting parameters

```
Sub cmdCancel_Click ()
    qbNewPasswd$ = ""
    Unload SetPassword
End Sub

Sub cmdOK_Click ()
    If Len(qbOldPasswd$) Then
        If txtOldPassword.Text <> qbOldPasswd$ _
            Then
            MsgBox "Incorrect old password", 48, _
                "Error"
            txtOldPassword.Text = ""
            txtNewPassword.Text = ""
            txtRetypePassword.Text = ""
            txtOldPassword.SetFocus
            Exit Sub
        End If
    End If
    If Len(txtNewPassword.Text) = 0 Then _
        Exit Sub
    If txtNewPassword.Text <> _
        txtRetypePassword.Text Then
        MsgBox "New passwords do not match",
            48, _
            "Error"
        txtNewPassword.Text = ""
        txtRetypePassword.Text = ""
    End If
    txtNewPassword.Text = ""
    txtRetypePassword.Text = ""
End Sub

txtRetypePassword.Text = ""
txtNewPassword.SetFocus
Exit Sub
Else
    qbNewPasswd$ = txtNewPassword.Text
    Unload SetPassword
End If
End Sub

Sub Form_Load ()
    If Len(qbOldPasswd$) = 0 Then
        lblOldPassword.Enabled = False
        txtOldPassword.Enabled = False
        lblNewPassword.Enabled = True
        txtNewPassword.Enabled = True
        lblRetypePassword.Enabled = True
        txtRetypePassword.Enabled = True
    End If
End Sub

Sub txtOldPassword_Change ()
    lblNewPassword.Enabled = True
    lblRetypePassword.Enabled = True
    txtNewPassword.Enabled = True
    txtRetypePassword.Enabled = True
End Sub
```

Figure 3 - Changing passwords

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the Project item of the Options menu in VBW). Consequently, it is the first procedure to run. Main() first checks if the program is already running: if not, it reads setup information from the BOXES.INI file. This is achieved using the Windows API call GetPrivateProfileString(). If BOXES.INI does not exist in the directory where the program is being run, then it is created with default settings.

The password is then unencrypted using the subroutine UnEncrypt(). Depending on the command-line parameter, the program either runs the screen saver or presents the user with the setup window.

Setting Parameters

Due to the simple nature of our screen saver I have presented only one setup parameter to control the speed at which the boxes are drawn (gbDrawBoxSpeed%). The code for my screen saver setup form is given in Figure 2. For the purposes of the example I have used a spin button in conjunction with a text box for setting the speed par-

ameter which is used to prime a timer interval on SAVER.FRM to control how fast the boxes will be drawn. For those of you who do not have VBW Professional, the text box alone will suffice. I have restricted the permissible input range to be between 1-10.

I have also provided a way for a user to set a password using the Change Password dialog. The new password is encrypted using the Encrypt() subroutine in MODULE1.BAS (see Figure 3). This is then written along with the global gbDrawBoxSpeed% to the file BOXES.INI using the Windows API call WritePrivateProfileString%().

Drawing Boxes

The screen saver form is setup at design time with a single timer control. When the form loads, the Windows API function ShowCursor() is used to hide the cursor. The original state of the cursor is taken so that it can be restored when the screen saver is terminated.

The timer interval is set according to the value of the setup parameter

gbDrawBoxSpeed%. At the heart of my screen saver implementation is the event Timer1_Timer() which draws a rectangle every time count reaches the preset interval. To create your own screen savers, simply customise the behaviour in this routine.

Unloading

When a key is pressed or the mouse is moved, the GETPASS.FRM is loaded, prompting the user to type in a password (so long as the screen saver has been set up with password enabled). If entered correctly, the screen saver is terminated. The VBW event which causes this response is Form_MouseMove() in Figure 4. However, to prevent the screen saver being unloaded as soon as it's loaded, the first instance of Form_MouseMove() must be ignored - and the mouse position checked to see if it has really moved. This is achieved by storing the x-y coordinates of the mouse position in static variables and exiting when these values are non-zero, or when they change.

If the password is correct, the screen saver is terminated and the user is returned to the Windows desktop. A timer control on this form (enabled when GETPASS.FRM is loaded), unloads the password prompt window after 10 seconds if no input is forthcoming (see Figure 5).

Creating an EXE

Depending on how you wish to run your screen saver you should compile the program using the Make EXE File option in VBW's File menu, specifying a .SCR or .EXE file extension to the filename. A .SCR file should be placed, along with the other screen savers, in your Windows system directory. Use the DESKTOP utility in Control Panel to enable your screen saver.

Passwords

One difficulty you should be aware of when writing screen savers in VBW concerns passwords. A password set using the standard Windows screen savers is not directly accessible from VBW. This is because the password is located in CONTROL.INI, but it is in an encrypted form (different to the encryption routines that I have employed). The procedures that Windows provides for gaining access to the password are in a static link library SCRNSAVE.LIB which is not accessible from VBW. I have seen

```

Dim CursorCount%
Sub Form_KeyDown
    Keycode As Integer, _
    Shift As Integer
    If Len(qbOldPassword) Then
        GetPassword.Show 1
    Else
        Unload ScreenSaver
    End If
End Sub

Sub Form_Load ()
    'Record original mouse-pointer show count
    CursorCount = ShowCursor(False) + 1

    'Hide mouse pointer
    Do While ShowCursor(False) >= -1
        Loop
    Do While ShowCursor(True) < -1
        Loop

    Timer1.Interval = 1000    gbDrawBoxSpeed%
End Sub

Sub Form_MouseMove
    Button As Integer, _
    Shift As Integer, _
    X As Single, _
    Y As Single

    Static Xlast, Ylast
    'Get current position in
    ' same variable types
    Xnow = X
    Ynow = Y

    'On first move simply record position
    If Xlast = 0 And Ylast = 0 Then
        Xlast = Xnow
        Ylast = Ynow
        Exit Sub
    End If

    'Exit only if mouse actually
    ' changes position
    If Xnow <> Xlast Or Ynow <> Ylast Then
        If Len(qbOldPassword) Then
            GetPassword.Show 1
        Else
            Unload ScreenSaver
        End If
        Xlast = 0
        Ylast = 0
    End If
End Sub

Sub Form_Unload (Cancel As Integer)
    'Restore original mouse-pointer
    ' show count
    Do While ShowCursor(False) > CursorCount
        Loop
    Do While ShowCursor(True) < CursorCount
        Loop
End Sub

Sub Timer1_Timer ()
    x% = Int(Rnd * Screen.Width)
    y% = Int(Rnd * Screen.Height)
    z% = Int(Rnd * Screen.Width)
    y2% = Int(Rnd * Screen.Height)
    colornum% = Int(16 * Rnd)
    ScreenSaver.Line (x1%, y1%)-(x2%, y2%),
        QBColor(colornum%), BF
End Sub

```

Figure 4 - The screen saver

```

Sub Form_Load ()
    GetPassword.Left = _
        (Screen.Width - GetPassword.Width) / 2
    GetPassword.Top = _
        (Screen.Height - GetPassword.Height) / 2
    Timer1.Enabled = True
    Timer1.Interval = 10000
End Sub

Sub Form_Unload (Cancel As Integer)
    Timer1.Enabled = False
End Sub

Sub Timer1_Timer ()
    Unload GetPassword
End Sub

Sub txtPassword_KeyPress _
    KeyAscii As Integer _
)
    If KeyAscii = 27 Then Unload GetPassword
    If KeyAscii = 13 Then
        If GetPassword.txtPassword.Text = _
            qbOldPassword Then
            Unload ScreenSaver
        End If
        Unload GetPassword
    End If
End Sub

```

Figure 5 - Verifying a correct password

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dynamic link libraries written by third parties which will provide this access from VBW - but these cost money for distribution rights.

There are two work-arounds. Either write your own encryption routine, as I have done in my example screen saver, or alternatively, write your own DLL for calling these Windows procedures.

The encryption routines that I have used were cribbed from a magazine article some time ago on encryption techniques. Unfortunately I can't remember which magazine it was, so I'm afraid I cannot provide a reference. Apologies to the author responsible for the original article. The routines work on the basis of a known keystring which is available to both the UnEncrypt() and Encrypt() procedures.

Final Thoughts

As I said above the actual screen saver graphics in the example are fairly routine. For those of you now fired with enthusiasm for writing your own screen saver, the limits are your own imagination.

The method I have outlined is only a framework for producing screen savers using VBW, but there *are* other ways. I'm exploring some of the Windows API calls to try to produce a

**You don't
always want to
logout every
time you leave
your desk to
grab a cup
of caffeine**

richer set of graphics displays using things like bit-block transfers.

I hope the techniques that I have presented here have been interesting and informative. If nothing else, I strongly urge those of you working

in a networked Windows environment to look at a password protected screen saver as a way of increasing the security of your network nodes, when they are left unattended.

EXE

Bruce Forman is a Network Supervisor at the University of East London and runs an independent consultancy offering programming services. He can be reached via email at bruce@uk.ac.uel.bkmain.

To obtain a copy of the complete Visual Basic source for the screen saver described by Bruce, please follow the instructions given in Column 1 of the Contents page. Mark your envelope 'SCNSAV'.

References

Visual Basic Programmer's Guide to the Windows API, Daniel Appleman, Ziff-Davis Press, ISBN 1-56276-073-4
Microsoft Visual Basic Workshop, John Clark Craig, Microsoft Press, ISBN 1-55615-512-3

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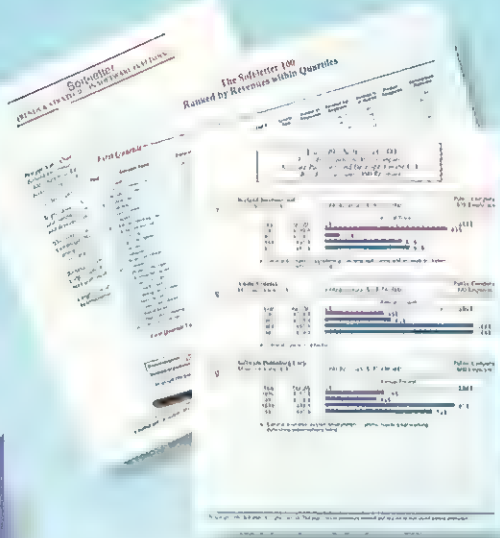
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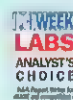
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Some Thoughts on Pointers & Arrays

Part 1: A C Perspective

Both C and C++ make extensive use of pointers, though the way experienced programmers use them in the two languages is often quite different. Very early in most courses on C++ the concept of passing a value by reference is introduced. Almost always this is followed by an explanation of why strings (C type) are not passed by reference. The upshot of this is that the C++ novice is faced with a new technique and then told not to use it. Confusing? Well I think so.

The perceived problem lies with the way C supports arrays and then proceeds to provide string facilities via arrays of char. In this article I want to set you thinking about the C implementation of arrays. I do not intend to present you with a detailed explanation - I think that would take rather more space than our esteemed Editor would want to provide. What I want to do is to suggest some directions you might explore in order to get a better understanding of what is happening when you start passing arrays around your program. To start consider:

```
char ar[20];
char *c;
```

No prizes for guessing the type of `c`; but what exactly is `ar`? (Remember it is the identifier that has a type.) Strictly speaking `ar` is of type array of 20 char. The trouble is that this does not have any practical meaning when applied to C code. In practice it is treated as a variation on `char *`. The problem lies in the whole superstructure that C builds on this foundation.

The index operator `[]` is defined such that it dereferences a pointer via C's pointer arithmetic. We can create dynamic arrays; with arrays of pointers we can create storage efficient multidimensional arrays. Now the problem: since arrays are treated as pointers, an array of pointers is indistinguishable from a pointer to a pointer. So how does the pointer arithmetic work? Consider the following:

```
char *suit[] =
{
    "Club", "Diamond",
    "Heart", "Spade"
};
char *fixed[6][3] =
{
    "AC", "BD", "EF",
    "GH", "IJ", "YX"
};
```

This creates an array of char. The task before you is to complete this code so that 'Diamond' will be displayed on the screen:

```
void test (????)
{
    printf("%s",????);
}

main()
{
    /* pass suit array */
    test(????);
    /* pass fixed array */
    test(????);
    return 1;
}
```

There are many possibilities which can be substituted for these queries. But can you find one that produces the desired result for *both* arrays? I will be fascinated to have an answer to this problem because it is a *real* problem in a *real* program which I have failed to solve. I need the first type of array for string literals, the second type for modifiable static storage and a potential third type for dynamic storage. All I can come up with is to abandon the second form and replace it with a dynamically assigned array, with a secondary array of `char *` to handle the individual data.

One of the design flaws in C is that we cannot explicitly state the first dimension of an array parameter; any attempt to do so will simply be ignored (ie `void fn (char c[5])` is converted to `void fn(char * c)` at compile time). However, if you really need to pass around fixed size arrays and have the type information checked you can do so by using a struct as a wrapper. For example:

```
struct T
{
    char x[20];
};
void test (struct T t)
{
    printf("%s",t.x);
}
int main()
{
    struct T t;
    strcpy(t.x,"This works");
    test(t);
    return 1;
}
```

Those of you who are still following this discussion will have realised that the prohibition on passing arrays by value has just

been side-stepped. In cases such as this it would usually be more appropriate to pass the structure address via a pointer, preferably type-qualified with `const` unless you intend to change an item in the array. The code now reads:

```
void test (const struct T * t)
{
    printf("%s",t->x);
}
int main()
{
    struct T t;
    strcpy(t.x,"This works");
    test(&t);
    return 1;
}
```

Painful though it may be, in C, fixed size arrays have to be handled by different mechanisms from those used to manage arrays of unknown size at code writing time (though they may be known at compile time). For one-dimensioned arrays we can manage if we are willing to take the risks implied by letting C treat arrays as pointers.

Note that, while a defensively written function can detect the passing of a null pointer, it cannot determine that the programmer has passed an address of a plain variable when an array was needed. I strongly advocate that the true size of the array is also passed as a parameter so that such accidents are not likely to happen without detection (ie the prototype reads `void fn (T t[], int n)` rather than `void fn(T t[])`). I must confess that I am disturbed by the amount of code that crosses my desk which contains prototypes such as:

```
void fn(T *t);
```

when the programmer knows that `t` should be an array. Just because the compiler treats arrays as pointers is no reason for the programmer to write them that way. `void fn (T t[])` is a safer prototype. Next time I will try to take a C++ programmer's perspective on this topic.

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Sam revisited

Peter Collinson continues his exposé of the SAM editor, with a voyage through its command language.

Last month, I talked about the visual aspects of Rob Pike's `sam` editor. This month I am going to continue the story and describe the command language that you use to make more than simple edits with `sam`. Let's recap a little, so I can put the later stuff in context.

The `sam` editor was designed for use with Plan 9 and has been ported for use with X. The editor has two sections: the editor part and the screen handling part. You can run the editor part on its own, but I have never done that. In normal use on an X screen, the editor consists of two cooperating processes: one handling the screen, keyboard and mouse; and the other dealing with the editing of the file. Figure 1 shows an editing session, I have reduced the size of the window for printing purposes. I have started the editor by saying:

```
sam xcal_edit.c xcal_memo.c
```

This has thrown a window up on the screen within which you can then create smaller editing windows. The bar at the top of the screen is added by my window manager, `twm`. In this

example the screen area is split into two: the topmost window is the *command* window used for typing commands and displaying status messages. The bottom window is the contents of the file `xcal_edit.c`. We'll see what happens to the other file later. You need to look at last month's article for a full description of how the visual interface works.

The Command Window

Many people use `sam` without recourse to the command language. However, there are often repetitive or complex editing tasks that are best done by careful application of commands. You can crawl through the file making changes with the mouse and keyboard. You can do this in *any* editor, but it's prone to error. You will often miss something that you wanted to change. It's also time consuming, since you are wasting your eye/brain power in doing something that the computer can do better.

The commands typed into the command window refer to the current file, selected by moving the mouse cursor

into the window and clicking with the left button. Input from the keyboard will now go into that window. All `sam` windows are 'click-to-type'. Simply moving into a window won't make it current: you must press the left mouse button.

To type commands, you need to move into the command window, again by moving the mouse and clicking the left button. The commands that you type here will apply to the last file that you were using. This can sometimes be counter-intuitive, as it isn't immediately obvious which file the commands will effect.

The command window contains a history of the commands that you have typed. Moving the cursor to the last line, typing a command and pressing return sends the line from the screen handler process to the editor process. The editor changes the file contents and updates the appropriate window. No big deal.

What's unusual is the ability to edit the text in the command window above the current input line using the normal cut-and-paste techniques that are used elsewhere in the editor. When you edit the previous history, the changes stay in the screen handling process until you explicitly send them to the editor process.

So the command window has an 'active' line where the commands that you type will make something happen in the editor. If you edit above the line to make a new command, then you invoke a command by *sending* it, using the menu called up by the middle mouse button. A demonstration is given in Figure 2.

I have selected the command window and replaced the `/` in the search command by a question mark, creating a reverse search command. The replacement is done by sweeping out the `/`

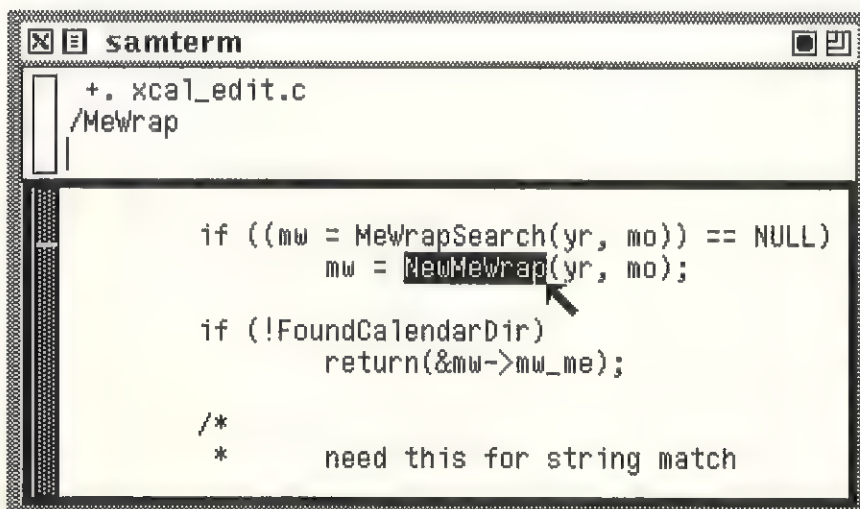


Figure 1 - Editing with `sam`

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and typing ?. I now select the created command and click on the middle button to get the edit menu. I choose send to enter the new command and start the reverse search. This sounds complicated, but isn't once you get used to it.

The send operation always transmits a whole line from the terminal process to the editor process. You create a whole new command, sweep it out and send it. The new command is echoed at the bottom of the command window as if you had typed it in yourself. This differs from common usage with history editing in shells, where you tend to build up the new command piece by piece on the prompt line.

The command window behaves a little differently from the other windows in the editor, even though it looks substantially the same. At first, it feels a little odd to have a window on the screen that looks the same as the rest but behaves differently. The command window is 'more equal than the others'. It is perhaps a weakness in the user interface. The point is that you know how to edit text in the command window; nothing special is needed to create the new text. After a little time, you begin to wish that you had this ability in your terminal emulator.

Basic commands

The commands for sam have their roots in the ed editor (and so will be familiar to ex or vi users). Some commands are very similar.

All these commands will print a result in the command window telling you that something has happened. Typical output from a normal start-up sequence is shown in line one in the command window in Figure 1. You see the name of the file that has been loaded, a full-stop to show that the file is current and a plus to show that the file has been read into the editor. This line is also added to the file menu that you can see by selecting the right mouse button.

Figure 3 shows the menu from the same editing sequence. Here we see the reference to xcal_memo.c that we entered on the command line. The bottom three lines refer to files: ~sam~~ is the command window, xcal_edit.c has been loaded into the editor (shown by the plus sign in

the menu); it has also been changed (shown by the single quote); and is the current window (shown by the full stop). The line that is highlighted xcal_memo.c has not been loaded into the editor, it just exists as a menu entry. Selecting the menu entry will load the file and start a new window.

Unlike the other editors that deal with line ranges, the commands that you type into the command window in sam deal with the area of text that you have swept out with the mouse, called dot. This is perhaps the fundamental change in sam. In vi or ed, dot marks the start of the current line - it's a position in the file. In sam, dot can be a position in the file (shown by a vertical bar) or a section of the file, starting and finishing at random positions and shown in reverse video. It can include newlines.

You can sweep out an area of the file with the mouse creating dot, you then apply a command to that area. Figure 4 gives some commands that make use of this idea.

Making sam interact with the external environment is reasonably easy. On my Sun, I have Berkeley's fmt program, which I use routinely to format text paragraphs by sweeping out the desired area and then saying |fmt in the command window. This sends the swept out area to the fmt command and captures its formatted output. It will replace dot with the new text.

I also have standard letter and fax templates containing the word ADDRESS where the address will be placed. I select this word and then run my address

program to insert the address details of the recipient. Banish typing, use commands that generate data.

The ! command is useful for looking at things, like perhaps running ls in the current directory. If the output of the command is more than a few lines, sam will divert it to a temporary file on /tmp and will tell you the name. You can then pick up the file and load it into a window.

There are also some commands that help with editing the data in dot (see Figure 5).

However it's more usual to use the mouse and visual editing techniques than these plain commands. I include them because they become more important when used with loops and conditional commands.

All commands can be preceded by an address specification to set dot before they are used. You can specify large ranges like the whole file:

0,\$ or some line range: 45,89

or perhaps some smaller set like 'from a string to the end of the line':

/fred;/\n/

Notice that we use \n to specify the end of a line since dot can span several lines. The use of the semi-colon here is the same as vi, it means 'look for fred and start looking after that for the new line'. You often want to search the whole file, so the address 0,\$ can be abbreviated to a single comma.

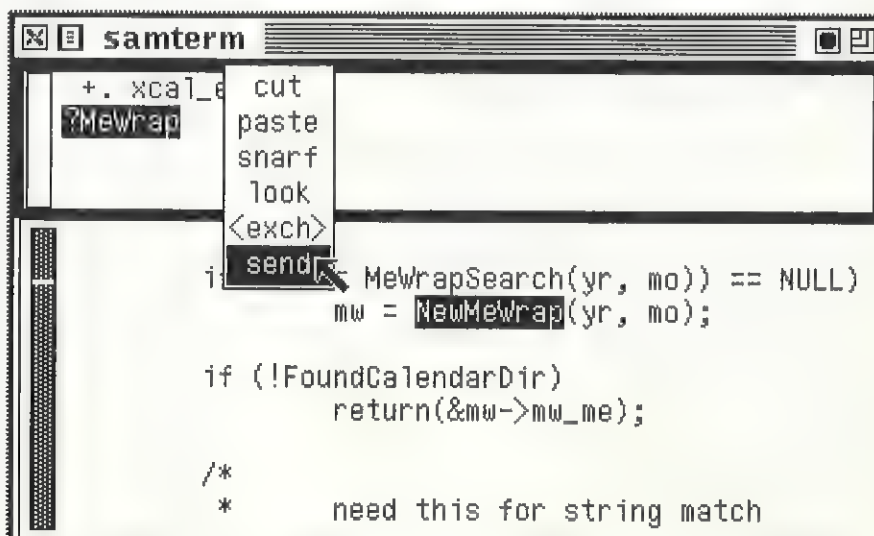


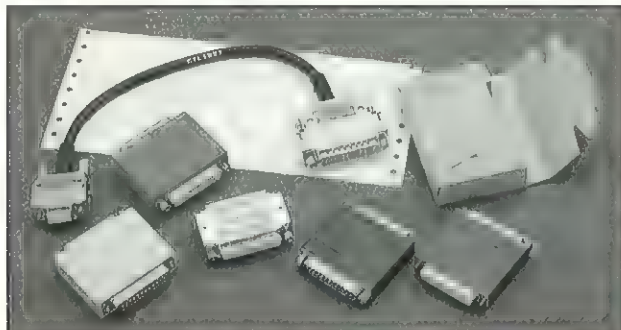
Figure 2 - Editing the command window and the edit menu

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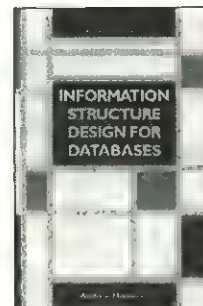
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Typing a line address will make you go to that line, as you might expect. Hitting return or a p command displays the current line in the command window and sets dot to it.

Loops and conditionals

A very common editing need is to make some repetitive change to the file. In sam, we set dot to some range and execute:

```
x/regex/ command
```

This finds all the matches in dot for the regular expression and then applies the command to them. When the command is executed, dot is set to the matched text. To change all the occurrences of 'black' in a file to 'white' you would say:

```
,x/black/ c/white/
```

Remember that the comma is a shorthand for 0, \$, so initially dot is set to the whole file. The file is searched for the string 'black'; when it is found dot is set to it and the text changed using the c command. I have separated the commands by a space, although this is not needed. The y command is the complement of the x command: it applies the command with dot set to the text between the matches.

The x and y generate loops. There are a pair of conditional commands that work with them. The g (for *guard* and not *global*) has a similar syntax to the x command:

```
g/regex/ command
```

This runs the command exactly once if dot contains a match for the expression. It differs from x which runs the command for each match. The g



Figure 3 - The file menu

<	Unix command	Replaces dot with the standard output of the command
>	Unix command	Sends dot to the standard input of the command
	Unix command	Replaces dot by the output of the command whose input is dot
!	Unix command	Runs the command

Figure 4 - Examples of commands which can use dot

command tests only for a match, and runs the command *without* changing the value of dot. The v command is the inverse of g, running the command if a match is not found.

The commands can be chained:

```
, x/*\n/ g/Baggins/ p
```

will print all the lines in the file that contain the word Baggins. Reading from left to right: the comma sets dot to the whole file; the x command splits the file into lines, setting dot to each of them before invoking the next command; the regular expression here reads: 'any character except newline ('\n'), repeated zero or more times (*) followed by a newline (\n)'. So the g command is run with dot set to each line of the file. It will invoke its command if it finds the word Baggins in the line. So the chain of commands will print all the lines containing Baggins.

If we wanted to search for every reference to a Baggins except 'Frodo Baggins', then

```
, x/*\n/ g/Baggins/
v/Frodo/ p
```

would do the trick. Well, nearly, it would fail if 'Frodo' appeared on one line and 'Baggins' on the next.

The notion of commands chains is powerful and easy to use. It's simple to get hold of the idea that you extract data from the file by setting dot and then progressively reduce dot to the object you are looking for.

Of course, the key to success is a good understanding of the regular expression syntax for matching strings. The syntax of regular expressions in sam differs in some ways from that used in the older editors vi and ed. The expressions in sam are a rethink on the way that things work, largely because they deal with embedded newlines. Don't get me wrong, your knowledge of vi or ex regular expressions will port

into sam. The differences are subtle but are easily learned. They are well documented in the various papers that come with the editor, so I'll leave you to seek that out if you are interested.

Multiple file support

I have already mentioned that you can load file names into the right-button menu without necessarily loading the files into the editor. This can be done from the command line by supplying sam with a list of files to edit. It can also be done using the B command. You type:

```
B newfile
```

into the command window. This opens the file called newfile in the current directory and allows you to set up a window that will display the file. You can give the B command a number of files:

```
B a b c
```

You will be prompted to open a window for the file c, but a and b will be just loaded into the menu. You can also pipe the output from a command into the B command:

```
B <echo *.c
```

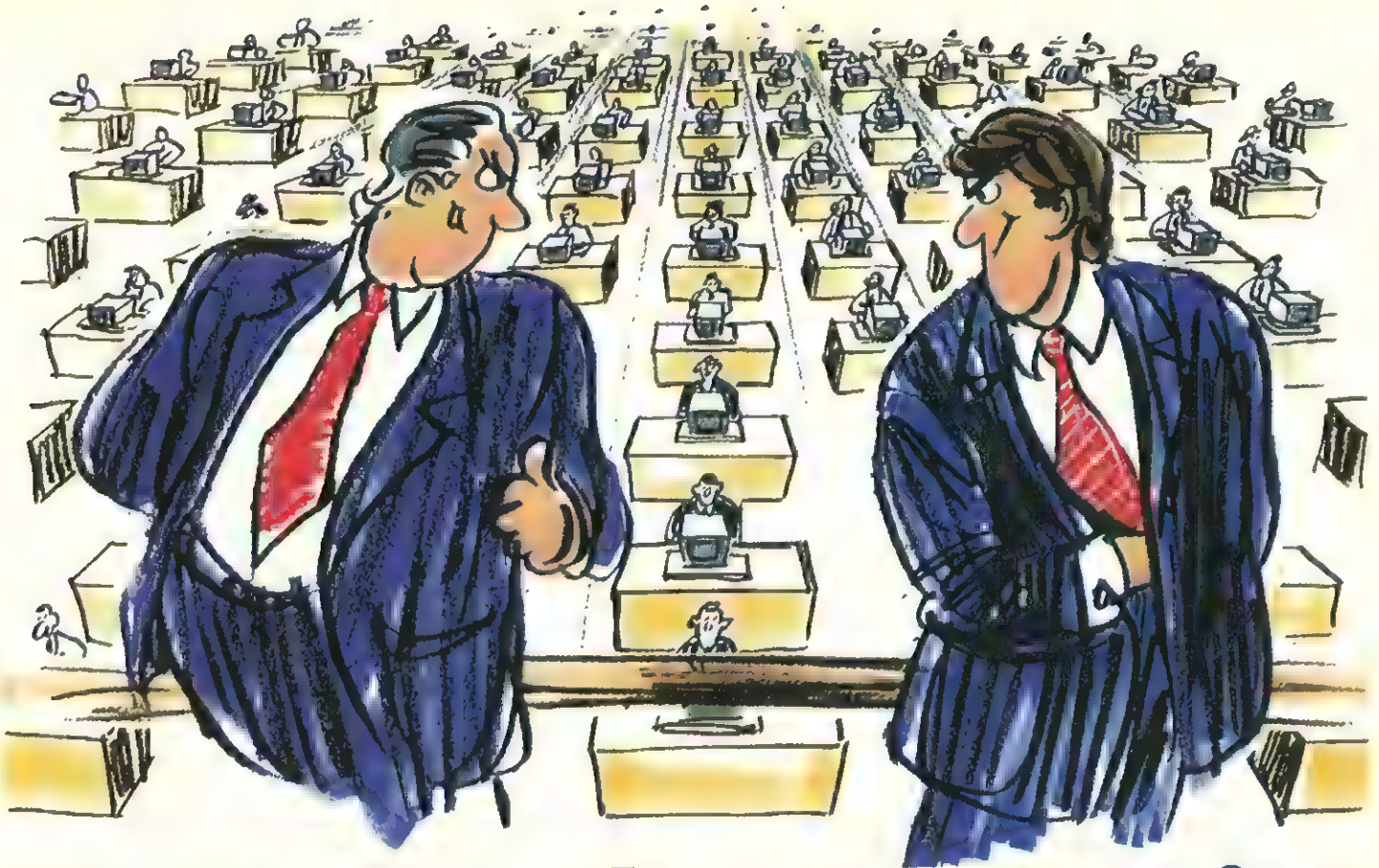
using the shell to create a list of files to be edited, or

```
B <grep -l look *.c
```

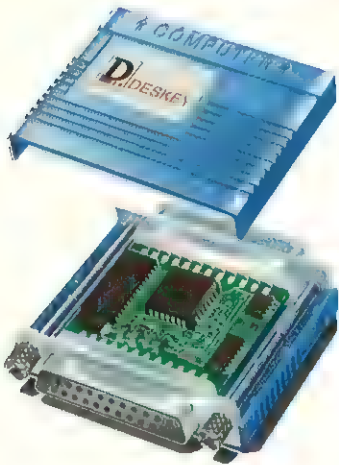
using grep with the -l option to generate a list of files that contain the string look.

The D command deletes files from the menu and from sam. Most of the time you do this from the close menu entry on the file menu, but a command is occasionally useful. Both operations don't touch the files on disk, just the references to the file held by sam.

The X command generates a loop like the x command, but the loop looks at



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the contents of the file menu. You can remove all the files that end in .c from sam with:

```
X/\ .c/D
```

This has other uses. Remember that the menu has some characters that say things about the status of the file? It has a + if the file is loaded, a - otherwise. It has a . (full stop) if the file is current and a single quote if the file has been altered. We can look at these characters in the X command and do things depending on the state of the file. This command line deletes all the unread files from the menu:

```
X/-/D
```

This one writes all the files that have been altered:

```
X/'/w
```

Naturally, there's an inverse of the X command. Y loops applying the command to all the files that do not match the command. So:

```
Y/\ .c/D
```

removes all the files that do *not* end in .c from sam. You can use these constructs in complex command sequences:

```
X/\ .c/ , g/main/ f
```

Which says: for all the files ending in .c, look in them for a string called 'fred' and print the filenames that match (the f command). Notice how dot is set to the file contents and the g command is used to search the file. The g command searches dot, but doesn't change its contents.

You might also want to see where the matches occur. Here you can use the ability of sam to group commands to

a/text/	Append text after dot
c/text/	Change text in dot
i/text/	Insert text before dot
d	Delete text in dot
s/regex/text	Substitute text for match of regular expression in dot
m address	Move dot after address
t address	Copy dot after address

Figure 5 -
Commands for editing dot

print the file name and the lines that match:

```
X/\ .c/ , g/main/ {
    f
    , x/*\n/ g/main/p
}
```

This looks in all the files ending in .c for a string called main as before. Now, a group of commands is run when the match succeeds. First the filename is printed. Then the whole file is split into lines by the x command, each line is searched by the second g for a matching string and the line printed if it is found.

Giving you access to the list of file names by a set of commands that mimic and interwork with the normal file, editing commands is a stroke of genius. The whole is hugely greater than the sum of the parts.

In addition to all these commands that work within sam, you will find a small shell script called B.sh. You install this somewhere in your search path as a command called B. You can now leave sam and wander about the file system, when you find a file or files that you are interested in editing, you say:

```
% B file1 file2
```

This sends a 'B' command to a named pipe on /tmp: sam is listening for commands to appear here and will execute the commands that you have sent.

Miscellany

There are a couple more commands that prove to be useful. The first is k. This sets a mark at the current cursor position. You address the data at the mark by using the single quote character. Let's imagine that you want to write from 'here' to some other point in the file. I am assuming that the whole region that you want to write does not fit into a single screen.

First, you set the cursor to 'here'. You then say: k in the command window to set the mark to the current cursor position. You can now go off and find the end point of the region and set the cursor to that position. Now saying:

```
' ,.w file
```

will write the file region. Actually, this is not new. Setting and using a mark exists in vi and ed.

The other command of interest is u for *undo*. This reverses the action of the last command and is useful for repairing broken edits. There's an interesting question about what should happen if you enter more than one undo command. The vi editor only gives you a single undo step, a further undo command will put the file back into its newer state. The u command on sam unwinds the file state back through the editing history. You can only go back in time since an undo cannot be undone.

Character sets

Plan 9 is probably the first system in the world to experiment with using the more complete character sets supported by Unicode. There is much argument about how to deal with 16-bit characters. Only the manufacturers of hard disks are really happy about doubling the file size of text files. One solution that has been proposed is the use of a multi-byte encoding called the File System Safe Universal Character Set Transformation Format, FSS-UCS-TF, or UTF for short. This is based on an 8-bit byte and uses a multi-byte encoding when needed. This is being pushed by X-Open. Plan 9 has generated a working version of this coding and sam has been programmed to use it.

Internally, sam uses a 16-bit character encoding called a *rune*. Externally, data is stored in sequences of 8-bit bytes. The good thing about the encoding is that it deals with ASCII transparently. If you only use 7-bit ASCII, the data remains compatible.

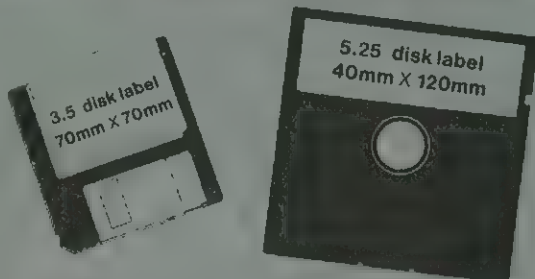
There is a slight problem with all this. If you type a control character like ^D into sam then it will be dealt with like any other character. However, your font must be able to show the control character as something visible, otherwise you will not see the character even if it is there. There are several X fonts that do this. I prefer to use the standard Sun screen-14 font, extending it to show control characters.

[EYE]

Peter Collinson is a freelance consultant specialising in UNIX. He can be reached electronically as pc@hillside.co.uk (although your mailer might be happier to put the address the other way round) or by phone on 0227 761824.

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Andrew, a Basic Programmer, talks frankly about his affliction:

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'Then when I got my first job, it was in Pascal, I think, and the project was several months behind. Well one day, I discovered this Basic compiler on the VAX and, like, before I stopped to think about it, I had done about two weeks' work in a day. And everybody was really pleased.'

'After that it was the same old story. I guess every Basic programmer has been through this. I set up a secret terminal in the Gents, and used to go there for about two hours a day. My productivity soared, the managers were well pleased, though the other guys on the project were pretty narked. It was probably one of them that sneaked on me...'

'So since then I've been wandering around, doing bits and pieces where I can. I know things are supposed to be changing, what with the new Visual Basics and everything, but the old attitudes, old prejudices are still there, beneath the surface.

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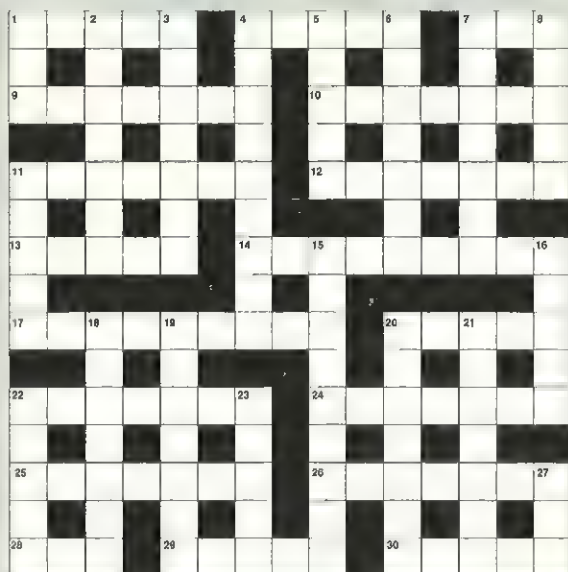
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OCTOBER .EXEWORD



ACROSS

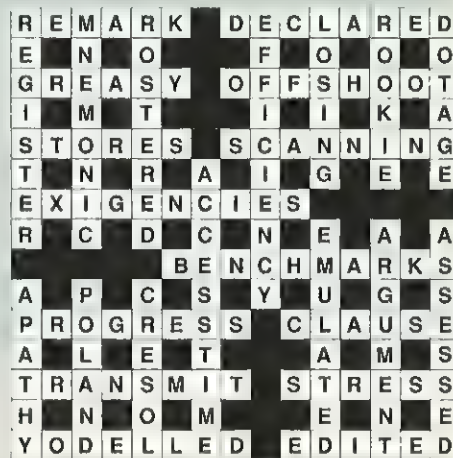
- 1 1 dn or the result (5)
- 4 The answer to discharge lies in the soil (5)
- 7 Narrow bus that may get you to work? (3)
- 9 Reflection concerning limit of 8 (7)
- 10 George brings article to his 22 dn (7)
- 11 Power of Victorian scientist and his time (7)
- 12 Clever technique the French charge gently (7)
- 13 About a hundred he puts in secret store (5)
- 14 Quite amazed at the drunkard's walk (9)
- 17 Freshwater alga beloved by school biologists (9)
- 20 Trunk road returns to autumn month, so brown (5)

- 22 Hard smart drink, maybe why he 14 (7)
- 24 Carrier of signals between UK and the EC (7)
- 25 Strange look from unsmiling star (7)
- 26 Non-biological body part that may use IT (7)
- 28 Prompt in the billiard hall (3)
- 29 Sink of the Nile (5)
- 30 Rubbery version of 27 (5)

DOWN

- 1 Go wrong with a message to say so (3)
- 2 5 takes chip to do with automation (7)
- 3 Loud? Ear makes it rolled food (7)
- 4 How a program passes through an eternal loop (9)
- 5 Modern machine with brilliant start in main node (5)
- 6 Sounding like factory time marker (7)
- 7 American draught blows in spelling software (7)
- 8 Set of peaks that defines the limits (5)
- 11 Candle cores annoying people get on (5)
- 15 Programmer (say) who follows no rules (9)
- 16 Speak monotonously in hard raw language (5)
- 18 Ask dbms in 25 sheets (7)
- 19 Run the mainframe like a surgeon... (7)
- 20 ... with his working tool (7)
- 21 Hanging prettily perhaps (7)
- 22 Logarithm chip is the basis of IT (5)
- 23 Waiting prompt with 1 ac sounds shrill (5)
- 27 Familiar American (from the South?) is for typesetting (3)

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SEPTEMBER .EXEWORD

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➤ CIRCLE NO. 117

Books

Avoiding the Old Bailey and furry dice for Windows.

Is IT Legal?

Behind the scenes, there's a lot more to computers and the law than the Computer Misuse Act and the Data Protection Act. What if you are a contractor and you want to claim copyright on programs that you've written for an employer? How do you go about patenting your programs, and will that stop people ripping you off? How do you draw up a watertight contract between a programmer and an employer? Do software licences have any legal strength? Can you use the law to prevent staff from misusing your company's LAN? Can you decompile commercial software?

Introduction to Computer Law is David Bainbridge's attempt to answer all these questions, and more, in a text that's free from legal jargon and readable by computer professionals. In this he succeeds admirably, producing a book that can be read all in one go, as a general back-grounder, or be kept as a reference work in case specific advice is needed.

As someone who writes a great deal about computer security, I've ploughed through a large number of legal texts and statutes in my time. It's refreshing to find something here that uses no legal jargon, yet still manages to explain the legal points extremely well.

Actually, I lie: there is a small degree of legal jargon, but it's all explained thoroughly.

Even if you're not interested in computing law for any commercial reason, the book is still an interesting read. There are, you will discover, a number of situations under which you are legally entitled to copy commercial software. And despite what the small print on the licence agreements tell you, there are cases in which you have a legal right to disassemble and/or decompile commercial software.

Introduction to Computer Law should be essential reading for any programmer, contractor, employer or software company that wishes to protect its assets. It should also be studied carefully by those corporate lawyers who insist on creating software licence agreements which are so poorly worded that even Oliver Reed would have a better chance of standing up in court. Allegedly.

Robert Schifreen

Title: *Introduction to Computer Law* Price: £18.95
 Author: David Bainbridge Pages: 245
 Publisher: Pitman Publishing ISBN: 0-273-60106-7

Adding to Windows

William Smith and Robert Ward's *Windows Custom Controls* begins by outlining the various features that every custom control must support in order to satisfy both Windows and the Dialog Editor, as well as important resource management considerations. It then goes on to detail how the solution to all, or at least the most tedious, of these requirements can be encapsulated in one common core. This core consists primarily of a common data structure with a complete set of functions to access its members and details of the necessary messaging interface (the usual WM_PARENTNOTIFY and WM_CTLCOLOR, you know the stuff). Here surfaced the first of only two gripes I had with the book: the authors define the responses to WM_CTLCOLOR differently from the Windows norm. Any deviation from Windows' orthodoxy always worries me. It usually leads to all sorts of problems later as you inevitably have to fight to impose your heresy upon the orthodox might of Windows. I can't see that this would be the case here, but...

The bulk of the book builds on this foundation to develop a number of different types of custom control, starting with a versatile static (output only) control and moving on to dynamic (input/output) controls, various buttons, hybrid controls, sub-classed controls and virtual memory controls. Each of these groups has a chapter to itself, with the full code listings at the end. Brilliant, I thought, I can get straight into custom control development right away, simply by copy the source from the supplied diskette. Hmm, no diskette: you would have thought that for £31.95 the publisher could have shipped a disk of the source with the book. Unfortunately you have to order it separately (or, like me, type in the code by hand). My second gripe.

Windows Custom Controls provides everything you need to know about custom controls and related topics that you could hope to find in a single book. I received the book on Saturday and by Monday I was using it, in anger, on a real, fee-paying, project. What better testimony could I give than that? Go and buy this book (and its companion disk) now.

Edward Kenworthy

Title: *Windows Custom Controls* Price: £31.95
 Authors: William Smith and Robert Ward Pages: 530
 Publisher: Prentice-Hall ISBN: 0-13-034497-4

Books Received This Month

Discrete Event Simulation in C	Kevin Watkins	McGraw-Hill	£34.95	0-07-707733-4	384
Constructing Logic Programs	Jean-Marie Jacquet	John Wiley	£19.95	0-471-93789-4	308
Database Graphics Programming	Jason J Manager	Sigma	£19.95	1-85058-504-0	315
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The code walkthru

Sugar and fudge finding their way into program listings...

'I want these pages clean, clean, clean. No rude four-letter words in any of my program listings. Lose the F-word, the B-word, the E-word. Wink Inc is a highly regarded software house. Our customers expect the best...'

'The E-word?' I quizzed, as I left her office. Phyllis Tyne, our new Technical Director. Joined us three months back, with 20 years 'cutting edge' development in PL/I under her spare tyre(s). Mizz Tyne, as she insisted on being called, was the chief developer of SOAP, a rather unique program from DIM Systems. (I believe the founders had a background in Basic. It's been DIM ever since.) SOAP was a tool for washing away rude words from code listings (as in 'wash your mouth with...'). Apparently, Mizz Tyne was responsible for filling the entries in the database of swear words. It's rumoured she went all the way up to Z, although noone has yet discovered her entry for Z.

Back at my desk, I fired-up WINCHAT, and dialled Dave. (It was Dave's code

which had been the subject of Mizz Tyne's meeting.)

'Philistine has seen your code, Dave. And she doesn't like it. She doesn't like it at all.'

'It's not fair you know,' he grudged. 'She got me last time.'

'Things aren't so bad, Dave,' I keyed tenderly. 'It's your colourful commenting. Let's have a look at what you've done.' What does that mean?

'What does what mean?'

'Second line in MyFunc69(). The comment. Explain: *watch out for potential zil*'

'Oh that,' he chuckled (implied in WINCHAT by the 'happy face' :-) symbol used on BBSs). 'That means a memory leak which grows and grows until it bursts, splatting your data segment with pus. I wanted to find the Z-word.'

'Yuck! She took particular dislike to the variable you declared in WontWork(). Why WontWork()? Come on Dave, what's the catch.'

With a beaming smile (several happy faces this time) he revealed his genius. 'That function will never compile. You see, the variable which Mizz Tyne so detests, will look like this - AComple-teF***Up - after SOAP has been at it.'

Two hours, three cups of coffee and 30 pages of listing paper later I made my way back to Mizz Tyne's office. 'Phyllis. Are you in? Here's the latest version of Dave's code listing. I hope it meets your approval.'

[EXE]

In the course of writing this article EXE acquired a new high tech tool, SOAP NT from DIM Systems. We are sorry for any misspellings which may have arisen as a direct result of its use. In particular, we would like to apologise in advance to Wink Inc (sorry, there I go again).

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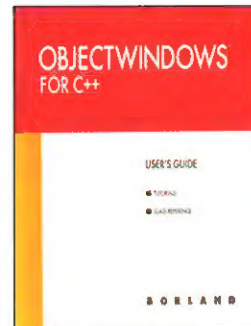
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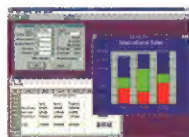
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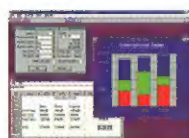


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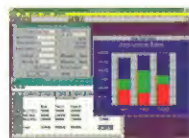
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DOS GRAPHICS



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